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Silvia Mejía-Arango
The University of Texas Rio Grande Valley

Luis Miguel Gutierrez

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Prevalence and Incidence Rates of Dementia and Cognitive Impairment No Dementia in the Mexican Population:

Data from the Mexican Health and Aging Study

Silvia Mejia-Arango, PhD and
El Colegio de la Frontera Norte, Mexico, tel: (52-664) 6316398

Luis Miguel Gutierrez, PhD
Instituto de Geriatria, Mexico

Silvia Mejia-Arango: smejia@colef.mx

Abstract

Objective—To estimate the prevalence and incidence of dementia and cognitive impairment without dementia (CIND) in the Mexican population.

Methods—The MHAS study is a prospective panel study of health and aging in Mexico with 7,000 elders that represent 8 million subjects nationally. Using measurements of cognition and activities of daily living of dementia cases and CIND were identified at baseline and follow up. Overall incidence rates and specific rates for sex, age and education were calculated.

Results—Prevalence was 6.1% and 28.7% for dementia and CIND, respectively. Incidence rates were 27.3 per 1,000 person-years for dementia and 223 per 1,000 persons-year for CIND. Rates of dementia and CIND increased with advancing age and decreased with higher educational level; sex had a differential effect depending on the age strata. Hypertension, diabetes and depression were risk factors for dementia but not for CIND.

Discussion—These data provide estimates of prevalence and incidence of dementia and cognitive impairment in the Mexican population for projection of future burden.

Keywords

dementia; cognitive impairment no dementia; hypertension; diabetes; depression; Mexican population

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The unprecedented declines in mortality and fertility have resulted in a rapid population aging process in most developing countries. Dementia has emerged as a public health problem as it is one of the most common diseases in the elderly and a major cause of disability and mortality. For Latin America, reported prevalence estimates of dementia ranged from 3.4% to 7.1%: Uruguay (4.03%), Chile (5.96%), Brasil (3.42%) (Ketzoian, Romero, Dieguez, Cairolo, Rega, 1997; Quiroga, Albala & Klassen, 1997; Nitrini, 1995; Herrera, Caramelli, Silveira, Mathias, & Nitrini, 1997).

A significant increase in the geriatric population is expected in Mexico during the next decades (Gutierrez-Robledo, 2006). However, little is known about the mental health status of the Mexican elders from a public health perspective. The existence of 500,000–700,000 individuals with dementia has been reported based on clinical reports (Navarrete and Rodriguez-Leyva, 2003). Recently the 10/66 dementia research group, a collective of researchers carrying out population-based research on dementia, non-communicable diseases and aging in low and middle income countries (Prince, 2009), reported prevalence

rates for dementia in Mexico city and in a rural area. Prevalence rates varied slightly: 7.4% for the urban area and 7.3% for the rural area (Llibre et al., 2008).

A number of risk factors for cognitive impairment with and without dementia have been reported (Kloppenborg, van den Berg, Kappelle & Biessels, 2008) including some which constitute the major causes of mortality among Mexican elders: heart disease (14.9%), diabetes mellitus (13.3%), stroke (8.6%), pulmonary disease (6.2%) and hypertension (3.5%) (INEGI, 2000). Chronic diseases as those mentioned, also have shown an increasing prevalence (Trejo-Gutierrez, 2004) in the Mexican population which, along with other socio-demographic characteristics as low education and high risk health behaviors (Gutiérrez-Robledo, 2006), increase the occurrence of dementia and the conditions preceding its onset.

The concept of cognitive impairment with no dementia (CIND), including mild cognitive impairment (MCI) has emerged as an important clinical entity because of its high risk of further cognitive decline (Tuokko et al., 2003). Although there is considerable heterogeneity in the use of the term (Zanetti et al., 2006) based on the different diagnostic criteria used (Busse et al., 2002; Knopman et al., 2003), three types of progression profiles have been described: improvement, stability or decline to dementia (Larrieu et al., 2002). The presence of comorbid conditions, the type of cognitive impairment (amnestic vs multiple cognitive domain) and the determination of impaired ADLs, have shown (Lopez et al., 2007) to influence this lack of stability. However, the likelihood of a progressive dementing disorder reported in population studies with different criteria, is high enough to be considered when compared with individuals without cognitive impairment (Tuokko et al., 2003: Lopez et al., 2007; Larrieu et al., 2002).

Nationally representative reports on the prevalence and incidence of cognitive impairment and it's relation with comorbidities and sociodemographic factors are necessary to allow primary and secondary prevention measures from the healthcare system. This epidemiologic study on cognitive impairment and dementia has two major aims: describe the prevalence and incidence of cognitive impairment with dementia and without dementia in Mexican population and analyze the variations by identifying disease risk factors.

Methods

Study Population

Participants came from the Mexican Health and Aging Study (MHAS), a nationally representative sample of the 13 million Mexicans 50 years of age and older in 2001. The respondents were selected from households included in the National Employment Study, a nationally representative survey conducted by the Mexican counterpart of the U.S. Census Bureau (*Mexican Health and Aging Study project overview*, 2006) Individual weights were designed to expand to the national population aged 50 and older at three levels: national, more-urban areas and less-urban areas (Wong, Pelaez, Palloni & Markides, 2006).

All subjects aged 60 or more were selected (N=7,166) for the present study. Most of them (63.4%) lived in urban areas, 53.4% were women, mean age was 69.4± 7.6 and 32.7% were illiterate. Based on the weighted data, the total sample represented approximately 8 million subjects from the elder Mexican population. Face-to-face interviews with the target subject or with a proxy respondent were conducted in the summer of 2001. Given that the cognitive status of subjects had to be determined based on their cognitive performance, those with missing data (two or more missing items on the cognitive tests) were excluded from the analysis. Subjects with missing data (n= 319) represented 4.4% of the total sample. They did not differ from the rest of the subjects in socio demographic factors (age: 71.9 ± 9.1 vs. 70.8

± 9.4; sex: feminine 50.8 vs. 53.5 and years of education: 2.9 ± 39 vs. 3.1 ±3.2) and number of diseases (0.97 ± 1.0 vs. 1.1 ± 1.0.) All subjects that completed the cognitive section were included in the analysis (n= 6846). During the months of May to September 2003, the MHAS follow-up interview was obtained using the same approach. All age-eligible persons interviewed in 2001 were targeted for follow-up. Based on the cognitive information, 88.5% of the baseline subjects completed the follow-up, 0.4% had missing data, 4.8% were lost to follow-up and 6.3% died.

Data collection

The MHAS cognitive section includes a core questionnaire for selected persons and their spouse if appropriate, and a proxy cognitive questionnaire for an informant who has knowledge of the target's daily functioning. After completing the section on health care services (section D), subjects move on to the cognitive section (section E) where interviewers follow a short algorithm that assures correct answers of the core cognitive questionnaire. In this study, subjects who could not speak Spanish (indigenous population) were not assessed. Those who had difficulties seeing objects closeup with their own glasses -- or with magnifying glasses provided by the interviewer -- or had problems holding a pencil, were evaluated with only two items of the core questionnaire (verbal memory). The other three items that involved visual scanning and copying two figures were omitted.

Instruments

The core cognitive questionnaire used in the MHAS is a brief version of the Cross Cultural Cognitive Examination (CCCE), a screening approach for epidemiologic and cross-cultural assessment designed by Glosser, Wolfe, Albert and colleagues in 1993. These attributes were particularly appealing given the prevalence of low education among older adults in Mexico. Concurrent validation of the test with respect to other well accepted screening instruments was determined. High specificity (> 94%) and sensitivity (> 99%) for detecting dementia were found in Guam and US mainland samples. Cultural bias was reduced excluding items with meaning restricted to a single culture. Education effects were minimized by not requiring literacy or arithmetic ability (Wolfe, Imai, Otani, Nagatani, Hasegawa, et al., 1992). These attributes were particularly appealing given the low education prevalence among older adults in Mexico. The CCCE permits rapid assessment of 4 cognitive domains using adaptations of widely accepted mental status tests. It includes five items that evaluate 1) verbal memory (coding) through an 8 word list; 2) verbal memory (recall); 3) visual-constructional abilities: subject copies two figures in 90 sec. each; 4) visual memory: recall of the two figures previously copied; and 5) attention through a visual scanning task where the subject has to detect stimuli (up to 60) embedded among other similar stimuli in 60 sec. The total score of the test ranges from 0 to 90 (see appendix).

Norms used for the CCCE in Mexico were based on respondents in the MHAS aged 50 to 59 (N=6292). Cut-points for each item (see table 1) were set using the 10 th percentile by sex and educational level. The cut-points were validated in a sample of 173 subjects from the memory clinic of the Instituto Nacional de Ciencias Medicas y Nutricion in Mexico City. Subjects were diagnosed as demented (N=107) or not demented (N=66) by a group of geriatricians and neuropsychologists blind to the CCCE scores and based on the DSM IV criteria for dementia. Sensitivity and specificity for the CCCE classification was estimated for the different number of failed tests. Failing two tests or more was considered the best cut-point (Sensitivity: 84.2% and Specificity: 100%).

Cognitive assessment of participants who were unable to complete the core questionnaire due to limitations in health, language or others, was done through the brief version of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). An informant who

had knowledge of the participant's daily functioning rated his/her cognitive status comparing it with how it was 2 years earlier. The brief version of the IQCODE (Jorm, 1994) is a 16 item questionnaire on cognitive decline in the elderly, rated on a 5-point scale from 1- "much improved" to 5- "much worse", with 3 representing "not much change." This short version showed high correlation (0.98) with the full version (26 items) and had comparable validity when judged against clinical diagnosis. A variety of cutoffs have been proposed for dementia screening, however in community samples, a cut-point of 3.4 has been accepted with sensitivity and specificity values of 89% and 94% respectively (Jorm, 2004).

For functional assessment the survey included four questions on Basic activities of daily living (BADLs): 1) walking, 2) bathing, 2) eating, 3) going to bed and 4) going to the bathroom, and four questions on instrumental activities of daily living (IADLs): 1) preparing a hot meal, 2) shopping for groceries, 3) taking medications and 4) managing money. Considering the effect of gender on some of the IADLs for the Mexican population (e.g. men do not usually prepare a meal and women do not manage money), subjects that needed help in 1 or more BADL and/or 2 or more IADLs were classified as dependent or functionally impaired.

Screening and diagnostic procedures

Figures 1 and 2 portrays the screening and diagnostic processes followed for the estimation of prevalence and incidence rates. Subjects with missing data in the CCCE (those who refused to answer or answered only one of the items) were excluded (n= 319) from the analysis leaving 6,847 subjects. Cognition was assessed directly with the target subject or through the proxy. Based on cut-points for the two instruments all individuals assessed with the CCCE and the IQCODE were combined in two global groups: cognitive normal and cognitive impaired. Groups were further classified based on functional performance. Those who received help with one or more basic activities of daily living (BADLs) and/or two or more instrumental activities of daily living (IADLs) were considered functionally impaired and those who didn't need help in any activity or needed help only in one IADL were considered functionally normal. Four groups were identified: 1) Subjects without cognitive impairment and functionally normal were the normal group 2) Subjects functionally impaired and with normal cognition were named the FINCI group (for the first letters of functional impairment not cognitively impaired). 3) Subjects with cognitive impairment and no functional impairment were the CIND (for the first letters of cognitive impaired no dementia). 4) Subjects with both cognitive and functional impairment were the Dementia group.

For incidence estimation prevalent cases of dementia were excluded. Normal, FINCI and CIND were the in risk groups for dementia and the normal and FINCI groups were the in risk groups for CIND. Subjects with missing data, those who were lost at follow up and those who had died in 2003 were identified and considered in the analysis. See figure 2.

Statistical Methods

Analyses were done using SPSS for Windows, version 16 (SPSS Inc., Chicago, IL). Descriptive statistics (mean, SD, percentages) are provided for demographic and health variables. Group differences were established using analysis of variance (ANOVA) with Scheffe procedure for pairwise contrasts for the continuous variables and χ^2 for categorical data.

Prevalence rates of CIND and Dementia were calculated using sample MHAS weights. Risk factors for dementia and CIND were estimated by logistic regression analyses. Incidence of dementia was estimated using data from three sources: Normal, CIND and FINCI subjects at

base line. For CIND incidence, data from normal and FINCI subjects was included. Person-years of observation used to calculate rates in this study included time from baseline until follow-up (two years). Although the two year delay between baseline and follow-up allowed time for incident cases to accumulate, it also meant that mortality rates had to be formally considered. To estimate the dementia and CIND status of the decedents, the proportion of subjects who developed dementia or CIND was used to calculate the proportion of subjects who died that could have developed dementia or CIND. Weighted data were used for prevalence estimates and for age strata (80 or more) and education level (7 or more) where samples were too small to be considered reliable.

Results

Prevalence rates

Prevalence of dementia and CIND are illustrated in Table 2. They included 357 cases of dementia and 1,719 cases of CIND. Based on the individual weights designed to expand to the national population, they represent 455,971 individuals with dementia and 2,148,491 CIND individuals in the elder Mexican population. The overall prevalence for dementia was 5.2% (weighted: 6.1%) Age- and sex-specific rates indicated increasing prevalence with age and higher prevalence in women; the group with the highest educational level had the lowest prevalence. The overall prevalence of CIND was 25.1% (weighted: 28.7%). Globally, data showed that prevalence increases with age and is higher in women until age 79. In subjects 80 years old and over men showed higher prevalence than women. An inverse relation between educational level and dementia and CIND was found.

Incidence rates of Dementia

The number of incident cases of dementia considering the baseline status of the subjects and the proportion of deceased were as follows. A total of 355 new cases of dementia represented an overall 27.3 (95% CI 24.5– 30.3) incidence rate of dementia per 1,000 person-years, 159 new cases were normal at baseline, 17.9 per 1,000 person-years (95% CI 15.3 – 20.9), 108 were CIND subjects, 31.4 per 1,000 person-years (95% CI 25.7 –37.9) and 88 were FINCI subjects, 128.3 per 1,000 person-years (95% CI 102 –158).

As expected, an increase in the incidence of dementia by age was found in the overall rates and in the sex-specific rates. Rates double with every decade of life. Difference between men and women were only observed in the oldest ages ($p<0.0001$).

Variations of incidence rates with years of education show the same pattern of prevalence rates. Incidence rates of dementia were 1.5 times higher in subjects with no schooling (34.3 per 1,000 person-years) than in highly educated subjects (21.9 per 1,000 person-years). The effect of education on incidence rates differs when considering age strata. The pattern of decreasing incidence with schooling is clearly observed in subjects with 60 to 69 years of age. After 70 years of age incidence decreases only in subjects with seven or more years of education.

Incidence rates of CIND

Normal and FINCI subjects constituted the two baseline sources for the 2131 subjects with CIND at follow-up. Overall incidence of CIND was 223 per 1,000 person-years (95% CI, 214.2 –233.2), 2021 were normal at baseline: incidence rate of 228 per 1,000 person-years (95%CI 218.4–238.3) and 110 were FINCI at baseline: incidence rate of 160 per 1,000 person-years (95% CI 132.5 –193.2).

Overall the incidence of CIND by age showed higher rates in individuals between 70 to 79 years old (236 per 1000 person-years) while in the other strata rates (206 and 201 per 1,000 person-years) tend to be similar (p=0.78). The overall sex-specific incidence rate is higher in women than in men (p<0.009); however this difference is only evident in women 60 to 69 years of age strata (p<0.04). In the other strata incidence rates do not differ (p=0.56 and p=0.86).

No education effect was observed on the overall incidence rate of CIND. However, by age strata, an inverse relation between education and CIND was found.

The analysis of the comorbidities showed that diabetes (23.1%), hypertension (47.2%) and depression (50.4%) were the most frequent conditions at baseline in the incident cases with dementia and CIND differ significantly with the in risk subjects. Results of logistic regression analysis controlling for the effect of age, sex and education, showed their role as risk factors: hypertension: (OR, 1.69; 95%CI, 1.31–2.17); diabetes: (OR, 2.06; 95%CI, 1.55–2.74), and depression (OR,2.27; 95%CI, 1.74–2.96). Pulmonary, heart and cerebro-vascular diseases were higher in the incident cases of dementia compared with the in risk group, but were not significantly associated. Other sociodemographic conditions which failed to show an effect were marital status and type of locality (more urban vs. less urban).

For incident cases of CIND, comorbidities didn't constitute significant risk factors. Only sociodemographic conditions such as sex, age, education and type of locality had a significant effect: women (OR,1.27; 95%CI, 1.12–1.43), age 70 to 79 (OR,1.31; 95%CI, 1.14–1.50), education levels: none (OR,2.04; 95%CI, 1.67–2.48) and 1 to 6 years (OR,1.81; 95%CI, 1.52–2.15) and rural locality (OR,1.28; 95%CI, 1.13–1.45).

DISCUSION

The analysis of data from the MHAS has provided rates of prevalence and incidence of dementia and cognitive impairment without dementia (CIND) from a large population-based cohort in which approximately 7,000 participants 60 years and older from rural and urban areas of Mexico were studied. Prevalence rates in the present study were 6.1% for dementia and 28.7% for CIND. Similar rates for dementia have been reported by other studies in Latin American populations (Ketzoian, Romero, Dieguez, Cairolo, Rega, 1997; Quiroga, Albala & Klassen, 1997; Nitrini, 1995; Herrera, Caramelli, Silveira, Mathias, & Nitrini, 1997). Specifically for Mexicans, a recent study of the 10/66 dementia research group reported prevalence rates of 7.4% and 7.3% for urban and rural localities. Although not greatly different, variations in estimates are probably related to the different instruments and methods used to define dementia. In this study cognitive instruments used (CCCE and IQCODE) do not include measures of executive function a domain that changes greatly with age (Kemper & McDowd, 2008) which might have resulted in a proportion of false negative subjects being excluded from the dementia group.

Variations in prevalence estimates of dementia by age, sex and education showed the expected findings and similar to other studies in different countries: an exponential increase in dementia by age, higher estimates in women only in the oldest subjects and decreasing rates with education (Ravaglia, Forti, Maioli, Martelli, Servadei, et al., 2005; Scarmeas, Albert, Manly, & Stern, 2006).

For CIND, the high prevalence estimates correspond to other studies that included subjects with characteristics shown to increase the probability of cognitive impairment: low educational levels (Graciani, Banegas, Guallar-Castillon, Dominguez-Rojas & Rodriguez-Artalejo, 2006), different racial groups (Plassman, Langa, Fisher, Heeringa, Weir, et al., 2008), and older ages (Unverzagt, Gao, baiyewu, Ogunniyi, Gureje et al., 2001; Busse,

Bischkopf, Riedel-Heller, & Angermeyer, 2003). The effect of increasing CIND with age and decreasing CIND with education also followed the pattern reported previously in the studies mentioned above. Sex differences in prevalence of CIND have been a more conflicting finding among studies. While some have found no sex differences (Busse, Bischkopf, Riedel-Heller, & Angermeyer, 2003) others report higher CIND prevalence for women (Di Carlo, Baldereschi, Amaduccio, Lepore, & Bracco, 2002). In the present study, women have slightly higher prevalence of CIND in the first two age strata but not in the last one.

We found higher incidence rates of dementia in subjects previously diagnosed as FINCI (functional impairment not cognitively impaired), followed by those with CIND (cognitive impaired no dementia). The most important characteristic of FINCI subjects as defined in this study refers to the impairment in activities of daily living not due to cognitive impairment. Although dependence on others for the activities of daily living is not a necessary condition for frailty, functional impairment is generally seen as integral to frailty (Rockwood, Fox, Stolee, Robertson, & Beattie, 1994). Subjects diagnosed as FINCI at baseline might reflect a frail condition where comorbid illness, poor health attitudes and signs of disease also described as part of the frailty index (Jones, Song & Rockwood, 2004) were present and increased the probability of converting to dementia. The association between frailty, dementia and mortality has been reported recently (Avila-Funes, Amieva, Barberger-Gateau, Le Goff, Raoux et al., 2009).

Epidemiological studies that report the risk of dementia in CIND subjects show heterogeneous rates. In the present study 6% of the CIND subjects progressed to dementia, a low estimate compared with studies in clinical settings (Petersen, 2004) but similar to other population-based studies (Larrieu, Letenneur, Orgogozo, Fabrigoule, Amieva, et al., 2002).

As in most community studies we found the overall incidence rate of dementia to double with every 10 years of age. We failed to show a different age gradient between men and women between 60 a 79 years of age. Women showed a higher dementia risk at very old age as in other studies (Ott, breteler, van Harskamp, Stijnen & Hofman, 1998; Miech, Breitner, Zandi, Khachaturian, Anthony, et al., 2002).

Different studies have found low educational attainment to be a risk factor for prevalence (Haan et al., 2003; Ravaglia, Forti, Maioli, Martelli, Servadei, et al., 2005) and incidence of dementia (Di Carlo, Baldereschi, Amaduccio, Lepore, & Bracco, 2002, Evans, Hebert, Beckett, Scherr, Albert, et al., 1997). Either the result of a protective process (Katzman, 1993), arising from slower biological aging in the more highly educated or the result of a compensatory process (Christensen, Korten, Jorm, Henderson, Jaco, et al., 1997) arising from greater verbal knowledge and expertise in the highly educated have been postulated as possible explanations for these findings. In the present study, the effect of education on incidence rates of dementia tends to diminish with age which might be explained by the interaction between age and compensatory processes in aging observed in other studies (Mejia, Giraldo, Pineda, Ardila & Lopera, 2003). Education serves to compensate for functional and cognitive impairments between 60 and 69 years of age. After age 70, only the higher educated subjects still compensate and exhibit lower incidence rates.

With respect to CIND incidence, the compensatory effect of education is less evident in global rates. The gradient of decreasing incidence with increasing education is present in each age stratum, although not as pronounced as in the dementia groups. Because of the cognitive instrument limitations mentioned above, classification of subjects with CIND might have included normal subjects in which education effect is not observed and tend to lower the impact of this variable in the whole group.

Hypertension and diabetes were the two vascular risk factors as was depression that demonstrated an increased risk of dementia in the present study. All three comorbidities have been considered as risk factors for dementia in other studies. Particularly for depression, the occurrence 10 years before the onset of symptoms has been considered a risk factor (Jorm, 2000). The role of diabetes as a risk factor for dementia has been associated with a reduction in cerebral perfusion due to microangiopathy (Manschot, Biessels, de Valk, Rutten, Van der Grond, et al., 2007). High systolic blood pressure has shown to be an independent risk factor for dementia at midlife (Kivipelto, Helkala, Laakso, Hanninen, Hallikainen, et al., 2002) and late life. In a follow-up study during 15 years higher systolic and diastolic blood pressure at age 70 were present in those who developed dementia at age 79–85 as well as in those with white-matter lesions (Skoog, Lernfelt, Landahl, Palmertz, Andreasson, et al., 1996). Although evidence suggests that cardiovascular risk factors appear more often in subjects with mild cognitive impairment than in general population, our study failed to find such association probably due to the inclusion of normal subjects in the CIND group.

There are several methodological and conceptual factors that need to be considered when evaluating the results. One refers to the way we defined the core diagnostic criteria for dementia and CIND. Unlike a clinical approach, it was based on formal tests used to assess cognition and activities of daily living in the MHAS. Subjects with impairment in both cognition and functional activities were classified as demented and those with impairment in cognition and independent in functional activities were the CIND subjects. Using a clinical approach based on the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV, APA 1994) criteria, subjects are allocated to a dementia diagnosis when meeting impairment in memory and at least one other domain of cognitive function; impairment in social or occupational functioning that represents a decrease from a previous level of functioning; not occurring exclusively during delirium; and not better accounted for by another mental disorder. The closest clinical diagnosis for CIND is that used for mild cognitive impairment (Petersen, 1991) which includes the following criteria: impairment in memory or other cognitive domain, intact activities of daily living, memory complaint and normal general cognitive function. In a population survey, contact with participants is more limited than in a clinical setting. The application of clinical criteria in the open set with elders is difficult because its time consuming and it may be difficult to examine and judge the degree of interference within work and social life due to cognitive impairment. This issue has been raised by some researchers studying cognitive impairment in developing countries (Llibre et al., 2008) who find that the prevalence of dementia according to the DSM IV varied widely. Difficulty in standardizing dementia assessment was considered an important source of this variation along with differences in population age structure, genetics, and lifestyle. For these investigators, DSM-IV dementia criteria substantially underestimate the true prevalence of dementia, especially in least developed regions, because of difficulties in defining and ascertaining decline in intellectual function and its consequences. They found that subjects who met DSM IV criteria for dementia had a higher severity profile due to the fact that the criteria prioritize reliability by restricting the diagnosis to more severe and incontrovertible cases; several domains of cognitive function must be affected, each with clear evidence of social or occupational impairment. In fact, one of the changes in the revision process for the DSM-V criteria for dementia and other cognitive disorders, considers the use of cut-points on formal testing (i.e., below the 3rd percentile), removing the term dementia and adding “Major Neurocognitive Disorder” and adding a category of “Mild Neurocognitive Disorders” that will resemble the Mild Cognitive Impairment diagnosis.

Second, although the criteria used in our study are central to the clinical diagnosis of both dementia and CIND groups, it’s also important to draw attention on the fact that the

cognitive assessment test used in the MHAS, has several weaknesses particularly in the lack of multidimensionality which is only partially accomplished through the assessment of verbal and visual memory, visual-constructional abilities, attention, and orientation while language, working memory and executive function are not assessed in the CCCE. This weakness might have affected the screening ability of the test and limited the inclusion of subjects with language or executive function impairments even though when compared with a clinical approach as the gold standard, sensitivity (84.2%) and specificity (100%) values of the CCCE in a Mexican clinic sample indicate it's a good screening instrument.

Despite these limitations, our study adds to the effort to document the cognitive status of Mexican elders who are a part of the population that is increasing dramatically while living in adverse conditions. The present study suggests that cognition in Mexican elders is heterogeneous, reflecting the participation of different conditions not only related to educational level but to other variables as economic situation, environmental demands, functional activities, etc, that may act as confounders of the real mental status of the population. Finally, the role of diabetes and hypertension as modifiable risk factors should be addressed in the design of public health interventions that could delay the increasingly serious public health problem that is dementia in Mexico.

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Appendix 1 Cross Cultural Cognitive Examination (CCCE) (Glosser, Wolfe, Albert, Lavine, Steele, Calne, & Schoenberg, 1993)

We will present you with a series of exercises to see how your memory works. I am going to ask you some questions and ask you to perform some tasks. You will find that some tasks are easy and others are more difficult. It may be that you do not know the answers to all of the questions. There is no problem with this. No one can correctly answer all of the questions at the first time. But it is important to make you best effort. If you are not sure of an answer, you can guess, or give me the best answer you can think of. Do you have any questions?

1. Copy Figures

Present the page with the two figures vertically oriented and read the following instructions:

"Draw the figure in the space below. Try to draw your figure exactly how it appears on my page. I am going to time you. I will indicate when you can start and when to stop".

Allow only one and a half minutes (90 seconds) to draw the figure.

Figure #1

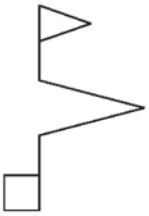
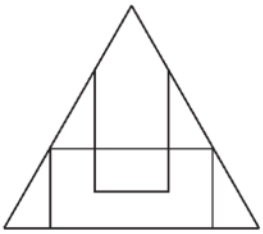


Figure #2



2. Verbal Memory (coding)

There are two lists of words for this item. Choose *list A* if today is Monday, Wednesday or Friday. Choose *list B* if it is another day. (List A: water, honey, bed, cloud, love, vote, plan, sum. List B: air, silk, chair, cross, hate, life, real, doubt)

Exercise 1

Instructions: "I am going to read you a list of words. Listen carefully. When I finish reading them, you should repeat all the words that you can. It does not matter in which order you repeat them".

Read the list of words clearly, one every two seconds. Do not repeat words after reading the list. Circle the words mentioned by the respondent. After the respondent finishes answering, wait 15 seconds and read the list again saying:

Exercise 2

Instructions: "I am going to read the same list one more time. Again, when I stop tell me all the words that you can remember, including those that you said before."

After the respondent finishes answering, wait 15 seconds and read the list again saying:

Exercise 3

Instructions: "I am going to read the same list for the last time. Again, when I stop tell me all the words that you can remember, including those that you said before

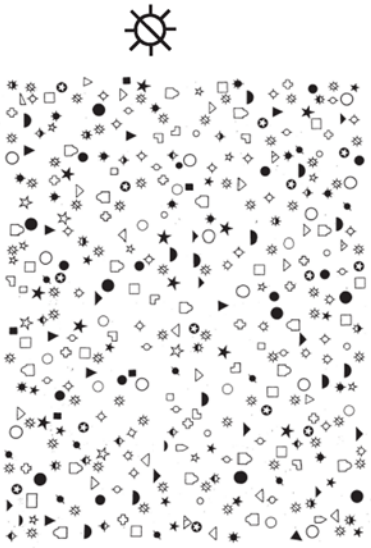
Exercise 1 (list A)	Exercise 2 (list A)	Exercise 3 (list A)
Water	Water	Water
Honey	Honey	Honey
Bed	Bed	Bed
Cloud	Cloud	Cloud
Love	Love	Love
Plan	Plan	Plan
Sum	Sum	Sum

Exercise 1 (list A)	Exercise 2 (list A)	Exercise 3 (list A)
Total Correct	Total Correct	Total Correct

3. Visual Scanning

Present the test page to the respondent so that it is oriented horizontally in such a way that the test page has a small dot at the top of the page. Show the sheet with the figure on it, and instruct the respondent:

“On the following page, please look for those figures that appear exactly the same as this one I am now showing you. Find as many figures as you can, and put a circle around each figure like I am doing. (WITH A PENCIL, CIRCLE AN EXAMPLE IN THE MIDDLE OF THE PAGE). Circle only the figures that are exactly like this one. Work as quickly as you can, until I tell you to stop” Begin to count the time when the respondent circles the first object, and finish 60 seconds from that point.



4. Visual Figure Recall

Present the respondent with the blank sheet so that it is oriented vertically, and instruct:

“Please recall the figures you drew before. Draw them again on this piece of paper”.

Suggest to the respondent that s/he can guess or give partial answers if s/he appears to be insecure. if the respondent produces a design of the visual scanning test, tell the respondent:

“Please draw the other figure that you drew before”.

Permit only three minutes to draw the two figures.

5. Verbal Delayed Memory Recall

Instructions: Remember the long list of words that I read before? Please tell me all of the words of the list that you can remember, in whatever order you wish.

Mark those words which the respondent mentions.

Recall List A
Water
Honey
Bed
Cloud
Love
Plan
Sum
Total Correct

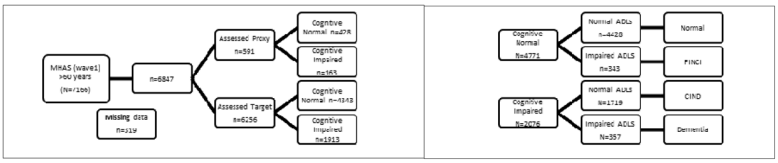


Figure 1.

Flow chart for screening and diagnostic procedures (Prevalence)
MHAS=Mexican Health and Aging Study, ADLs=activities of daily living, FINCI= functional impairment not cognitively impaired, CIND= cognitive impaired no dementia

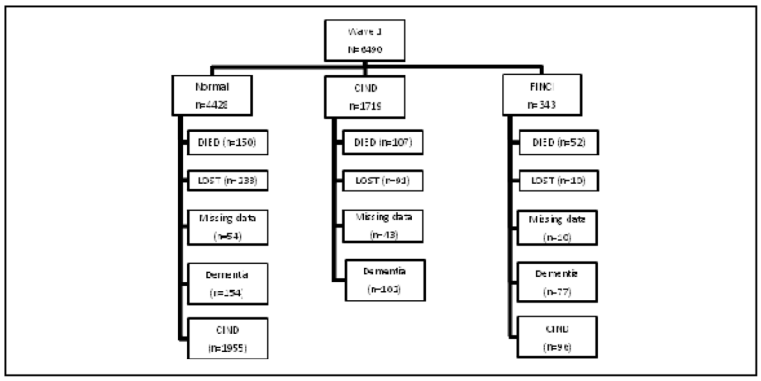


Figure 2.
Flow chart for screening and diagnostic procedures (Incidence)
FINCI= functional impairment not cognitively impaired, CIND= cognitive impaired no dementia

Table 1

Cut-points for the Cross Cultural Cognitive Examination (CCCE) items by sex and education.

	Men			Women		
	Education levels			Education levels		
	Illiterates	1 to 6	7 or more	Illiterates	1 to 6	7 or more
Verbal Memory-coding	3	3	4	3	4	4
Verbal Memory-recall	3	3	4	3	4	4
Visual-constructional	0	1	2	0	1	2
Visual Memory	0	0	0	0	0	0
Visual Scan	6	11	19	3	10	19

J Aging Health. Author manuscript; available in PMC 2013 January 28.

Table 2

Prevalence of Dementia and Cognitive Impaired No Dementia (CIND). Rates are shown by sex, age and education

	Dementia		Cognitive Impaired No Dementia	
	Rate	**95% CI**	**Rate**	**95% CI**
Overall	5.2	(4.7 –5.8)	25.1	(23.1 – 26.3)
Male	2.1	(1.8 –2.5)	10.7	(9.9 – 11.5)
Female	3.1	(2.7 –3.6)	14.4	(13.5 – 15.3)
By age, y				
60–69	1.1	(0.8 –1.3)	11.8	(10.9 – 12.6)
70–79	1.9	(1.6 –2.3)	9.3	(8.5 – 10)
80>	2.2	(1.9 –2.7)	4.4	(3.6 – 4.6)
By education, y				
0 yrs	2.4	(2.1 –2.8)	10.4	(9.7 – 11.2)
1–6 yrs	2.3	(1.9 –2.7)	11.9	(11.1 – 12.7)
7> yrs	0.5	(0.3 –0.6)	2.8	(2.4 – 3.2)

CI=confidence interval

Table 3

Incidence of Dementia (Per 1,000 Person-years) by age category and sex

	Women				Men				Total			
Age	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**
60–69	4206	66	15.7	12.1–19.9	3596	41	11.4	8.2–15.4	7800	107	13.7	11.2–16.5
70–79	2050	80	39.0	30.9–48.5	1946	56	28.8	21.7–37.4	3996	136	34	28.5–40.2
80>	646	58	122.1*	121.3–122.9	536	32	98.1*	97.2–98.9	1182	90	111.6*	111–112
Total	6902	204	29.5	25.6–33.9	6078	129	21.2	17.7–25.2	12980	333	25.6	22.9–28.5

yrs= years,

CI= confidence interval,

* rates based on weighted data

Table 4

Incidence of Dementia (Per 1,000 Person-years) by age category and education

	0 yrs of education				1 to 6 yrs of education				7 or more yrs of education			
Age	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-Yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**
60–69	2018	47	23.3	17.1–30.9	4392	56	12.7	9.6–16.5	1388	4	1.8*	1.7–1.9
70–79	1418	52	36.6	27.4–48	2056	75	36.4	28.7–45.7	514	9	11.2*	10.8–11.5
80>	528	37	70	49.3–96.5	532	43	80.8	58.9–108.8	116	10	45.9*	45.4–46.4
Total	3964	136	34.3	28.7–40.6	6980	174	24.9	21.3–28.9	2018	23	21.9*	21.7–22.1

yrs= years,

CI= confidence interval,

* rates based on weighted data

Table 5

Incidence of CIND (Per 1,000 Person-years) by age and sex

	Women				Men				Total			
Age	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence rate/1000**	**95% CI**
60–69	3226	714	221	205–238	2962	565	191	175–207	6188	1278	206	195–218
70–79	1336	330	247	221–275	1392	316	227	202–254	2728	646	237	218–256
80>	368	75	204	163–255	258	51	197	147–259	626	126	201	167–239
Total	4930	1119	227	214–241	4612	932	202	189 –215	9542	2051	215	205–224

yrs= years,

CI= confidence interval,

* rates based on weighted data

Table 6

Incidence of CIND (Per 1000 Person-years) by age and education

	0 yrs. of education				1 to 6 yrs. of education				7 or more yrs. of education			
Age	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95% CI**	**Person-yrs at risk**	**Cases (n)**	**Incidence Rate/1000**	**95%CI**
60–69	1396	332	237	212–265	3592	778	216	201–233	1196	169	141	121–164
70–79	860	226	263	229–299	1484	350	236	212–262	376	70	186	145–235
80>	282	56	271*	2608–273	276	56*	255	253–257	64	14	48*	46–49
Total	2538	614	242	223–261	5352	1184	221	208–234	818	253	155	136–175

yrs= years,

CI= confidence interval,

* rates based on weighted data