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Research Article

Predominant Objective Cognitive Function Groups and their Association with Risk Factors in Older Adults: Cross-Sectional Study

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Abstract

Background: The epidemiological characterization of the predominant population groups by cognitive function allows supporting health policies to prevent dementia in Older Adults (OA).

Objective: To analyze if there are association among predominant cognitive function groups and lifestyle factors, comorbidity and motor function in OA.

Materials and Methods: Cross-sectional study with a probabilistic sample of insured OA, >60 years old of either sex. Sociodemographic, habits, comorbidities and motor function data were the risk factors. Data for hierarchical cluster analysis were subjective and objective cognitive function, sex and academic level. Cognitive function from population groups defined according to DSM-5, and their association with risk factors.

Results: A sample of 350 OA, 65 ± 7.4 years old. Cluster analysis grouped four groups: i) without Neurocognitive Disorder (NCD), ii) with major NCD, iii and iv) with minor NCD in OA ≥70 years and <70 years. The factors associated with major NCD were unqualified work, Living Alone (LA), Diabetes Mellitus (DM), Hypertension (HT), reduced March Speed (MS), frailty and alteration of Activities of Daily Life (ADL). The minor NCD >70 years: unqualified work, LA, DM, frailty and alterations in ADL; and finally, minor NCD <70 were unqualified work, LA, DM, HT, dyslipidemia, obesity, cardiac diseases and hypothyroidism. Physical activity was a protector for the three groups. The likelihood value for major NCD had lower values than the model soft heminor NCD groups.

Conclusions: There are association among lifestyle factors, comorbidity, and motor function for protection and risk for the predominant cognitive function groups.

Keywords: Dementia Prevention; Cognitive Decline; Lifestyles; Motor Function

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Introduction

Pathological aging causes mild cognitive impairment or dementia though several risk factors [1]. In 2015, the Alzheimer's Association indicated that there were 47 million people with some type of dementia in the world, of which 60% lived in low- and middle-income countries [2]. The number of people living with dementia is expected to triple to 150 million by 2050 [3]. In Mexico, as in the rest of the world, older adults are expected to reach 36 million by 2050, of which 3.5 million will live with dementia, due to the increase in risk factors for dementia in the population [4].

Cohort studies and meta-analyses have been able to determine 12 risk factors for dementia, including low education, hearing loss, traumatic brain injury, high blood pressure, alcoholism, obesity, smoking, depression, social isolation, physical inactivity, type 2 diabetes mellitus and air pollution [5]. Given the population attributable risk factors, it is possible to prevent 40% of dementia cases [6]. The protective factors that have been reported are higher academic level (>6-15 years), weight loss, physical exercise, healthy diet, and cognitive reserve [7]. Successful interventions to modify lifestyles have reduced the incidence of dementia in high-income countries [6], but this has not been possible in low-middle-income countries, where 60% of worldwide dementia cases occur [5].

Interesting, Mexico is an upper-middle-income country, but in matter of health care, it still has insufficient reduction of the risk factors for dementia, such as low levels of schooling, high sedentary lifestyle, smoking, obesity, DM2 and high blood pressure [8]. Therefore, it is possible that these factors will further increase the number of cases estimated for 2050 [9].

In countries with emerging economies, there is scarce information on the relationship among the lifestyle factors, comorbidity and objective cognitive function. For this reason, this study investigates the Predominant Objective Cognitive Function Groups (POCFG) concerning subjective (subjective memory complaint) and objective (alteration of global cognitive function by domains of memory, executive function, attention, and language) cognitive function, considering age, sex, and educational level in a sample from Mexico City. Once characterized, the association with lifestyle factors, comorbidities, and motor functionality was determined.

Methods

Study Design and Setting

We conducted an analytical, cross-sectional research. The sample was recruited during October-December 2019, at Centro Medico Nacional Siglo XXI, Mexico (R-2018-785-095.). This article was written in accordance with the Checklist for reports of observational studies STROBE Statement [10].

Participants

The participants were randomly selected from a list of 2600 OA from two primary care units of the Instituto Mexicano del Seguro Social, the largest national public health provider, from whom an n=1538 OA had a telephone number. The recruitment of the sample began through telephone calls. We were unable to contact n=1158 OA due to the following reasons: 1) they did not answer, 2) the telephone number was inactive, 3) who answered the phone mentioned that the OA no longer lived in that place, 4) the OA was not at home and did not return the call, 5) who answered the phone mentioned that the OA was dead, 6) the OA said he/she had not time to participate in the study, 7) the OA said that he/she was out of the city (Figure 1). Participants included were adults 60-95 years, either sex, with one or more risk factors for dementia, with the evaluation of Subjective Memory Complaints [SMC] [11], and objective cognitive function [Mini Mental State Evaluation or MMSE [12] and Montreal Cognitive Assessment or MoCA [13,14] and informed consent letter. OA was excluded with severe depression (Geriatric Depression Scale of Yessavage or GDS) score <15 points [15] and with delirium by clinical neurological examination. Adults with incomplete data were eliminated.

Outcomes, Data Sources and Measurement

Subjective memory complaints: The presence of a self-reported subjective memory complaint was quantified using the following probing questions: Have you recently felt that your memory or thinking ability has worsened or decreased? (Yes/No); in addition, we added another question for the caregiver: Does your family member have difficulty remembering recent events? We considered the existence of the subjective memory complaint when the answer was affirmative with the from the caregiver report [12].

Objective cognitive function: Objective cognitive function was measured by i) the Mini Mental State Evaluation (MMSE), an instrument with five domains: orientation, immediate memory and delayed recall, attention and calculation, language and construction. The score ranges from 0-30 points and is categorized 1) mild cognitive impairment ≤24 and while mild cognitive impairment >24 [13,14]. ii) The Montreal Cognitive Assessment (MoCA), also a screening test with the domains of memory, visuospatial ability, executive function, attention, concentration, working memory, language and orientation. With 0-30 points, point is added for people with schooling higher or equal to 12 years. The cut-off point for Mild Cognitive Impairment (MCI) is ≤26 [15].

Motor functions: was a composite variable: i) The basic activities of daily living (Katz Index) comprised 6 items: eating, dressing, bathing, urinary/fecal continence, transferring and using the toilet. A total score of 6 points was considered independence [16]. ii) Gait speed is the time that takes for the OA to walk 4 m/s. The risk of adverse outcomes is considered when decreased performance as part of the component that defines sarcopenia <0.8 m/s [17]. iii) The grip strength was measured using a grip dynamometer, placed on the dominant hand. Two attempts were made, the second attempt after one minute of resting. This evaluation was carried out with the subject sitting on a chair with the back, shoulders and forearms in a straight position and the elbow at a 90° angle and with both feet on the ground [18,19]. iv) Frailty phenotype Spanish version has five components: unintentional weight loss, exhaustion, slow gait, poor grip strength, and low level of physical activity. The presence of three corresponds to frailty [18,19].

Demographic Variables and Risk Factors for Dementia

The questionnaire to obtain the general data and the measurements was applied by a qualified nurse or gerontologist. Sociodemographic characteristics were collected, such as age (years), sex (male or female), educational level (years), marital status (single/separated/divorced/widowed & married/common-law partner), occupation (professional, administrator, office worker, salesperson, craftsperson, shift manager,

service provider, worker, farmer, homemaker, merchant, technician, does not work), living alone (no/yes). Habits evaluated were: smoking (present), self-reported alcoholism (present), and physical activity (Yes/No). While comorbidities considered were: obesity (BMI >30), diagnosis of hypertension high blood pressure (present), diabetes mellitus (present), dyslipidemia (present), heart disease (present), cerebrovascular disease (present), chronic obstructive pulmonary disease (present), chronic Parkinson's (present), and hypothyroidism (present). Depressive symptoms were estimated with, the CDS-15-point geriatric depression scale was used; the presence of clinically significant depressive symptoms was considered ≥5 points [11].

Bias: Cognitive functions with the DSM-5 criteria were not evaluated with neuropsychological tests.

Study size: The formula was used to calculate the sample size for a proportion from a population $[n = (N * Z\_\sigma\text{^}2\, p * q)/(d * (N-1) + Z\_\sigma\text{^}2 * p * q)]$ [20], where α=0.05, Zα=1.96 and d= 5%. The proportion of events of interest in the population considered was MCI of 7.0% reported by the ENASEM 2016. The population of older adults assigned to UMF #1 was 6775 and UMF 10 # 11186 older adults approximately. The calculation of the sample was 146 older adults, plus 30% losses, the minimum sample will be 190 older adults.

Clusters

The groups with similar cognitive functions were identified through the analysis of the hierarchical cluster method, the Ward method. The similar cognitive functions were gathered from: i) subjective cognitive function (self-reported subjective memory complaint), ii) objective cognitive function (orientation, visuospatial ability, immediate memory, delayed recall, attention, calculation, language and construction, executive function dimensions obtained with the MMSE and MoCA) were included, as well as iii) age, iv) sex and v) educational level. All the data used were standardized to "z" values.

Statistical Analysis

Data are described as mean and standard deviation when continuous variables followed a normal distribution, otherwise median and interquartile range was reported. For discrete variables, the percentages and frequency are reported.

The clusters were characterized with descriptive statistics, and the MMSE and MoCA scores per cluster were plotted with a box-whisker plot. For the difference between the groups of cognitive function by age, sex, level of schooling, global subjective and objective function, the variables with a normal distribution, the Student-t test was applied, while for the variables with a nonnormal distribution, the difference between medians were compared with the Mann Whitney-U test. For the discrete variables, the difference in proportions was evaluated through the chi-square test. A significant difference was considered significant when p value <0.05. The association between the groups formed with lifestyle risk factors, comorbidities, motor functionality and POCFG was evaluated by the odd ratio (OR) and risk was considered with the OR value >1 and a protective factor with the OR value <1; the estimation was considered statistically significant when the confidence interval did not exceed the unit or the value p <0.05. The group without Neurocognitive Disorder (NCD) was used as the reference group. The likelihood values of the POCFG were obtained and plotted with the multiple logistic regression model (M) for M1 with lifestyle characteristics, M2 with comorbidity factors and M3 with motor functionality. The statistical package IBM SPSS (Statistical Package for the Social Sciences), version 26, was used.

Table 1: Characteristics of the study sample.

Characteristic	n350
Demographic	
Age (years); mean (SD)	65 ± 7.4
Mean education level (years); mean (SD)	9.5 ± 5
Sex (female)	67.3%
Marital status	
Married/Common law	63%
Single/separated/divorced/widowed	37%
Occupation	
Professional	10%
Administrator, clerk, salesman	14.2%
Craftsman, foreman	4.8%
Service provider	39.3%
Worker or peasant	13.7%
Housewife	2.8%
Businessman	2.6%
Technical	6.8%
Unemployed	5.8%
Lifestyle	
Living alone (present)	17.3%
Smoking (present)	30.2%
Alcoholism self-report (present)	21.7%
Physical activity (Yes)	46.7%
Comorbidities	
Obesity (BMI> 30)	36.5%
High blood pressure (present)	52.1%
Type 2 diabetes mellitus (present)	42.2%
Depressive symptoms (present)	14.8%
Dyslipidemia (present)	60.7%
Heart disease (present)	44.2%
Vascular cerebral disease (present)	4.%
Chronic obstructive pulmonary disease (present)	8.5%
Parkinson's disease (present)	1.7%
Hypothyroidism (present)	3.4%
Motor Functionality	
Subjective memory complaint (present)	44.2%
Global Cognitive function MOCA (score:18-30), mean (SD)	23.62 ± 3.76
Global Cognitive function MMSE (score:24-30), mean (SD)	27.17 ± 2
Frailty (present)	12.8%
Basic Activities of Daily Living by Katz (independent)	69.8%
Gait speed (m/s) median (IR)	4.72 (0.0-14.42)
Grip strength (kg) Median (IR)	20 (2.0-46)

IR: Interquartile Range; SD: Standard Deviation; MOCA: Montreal Cognitive. MMSE: Mini-Mental State Examination.

Results

Participants and Descriptive Data

For this study, a sample of 350 older adults was obtained, where the majority was women (67.3%) with a mean age of 65 years (±7.4). The average level of education was 9.5 years (±5), the occupation with the highest percentage was a technical service provider. Less than 35% of the participants had a history of smoking and alcohol consumption, and less than half of the sample mentioned physical activity. The most frequent comorbidities present were dyslipidemia (60.7%), high blood pressure (52.1%) and DM2 (42.2%). The average cognitive functionality with MoCA 23.62 (±3.76) and with MMSE 27.17 (±2). With respect to basic activities of daily living, more than 60% were independent, walking speed had a median of 4.72 m/s (0.0-14.42) and for grip strength, the median was 20 kg (RI:2 -46). The 12.8% of the participants had frailty. The general characteristics of the sample are described in (Table 1).

Table 2: Comparison of the sociodemographic characteristics and objective cognitive function among the clusters obtained from the study sample.

Type of possible Neurocognitive Disorder (NCD)	Without	Major		Minor		Minor	
Characteristic	C1 n=99	C2 n=30	p-value C1&C2	C3 n=66	p-value C1&C3	C4 n=152	p-value C1&C4
Prevalence (%)	28.1	8.5	0.0001*	18.8	0.0001*	43.2	0.0001*
Age, (years) (mean ± SD)	71 ± 5.8	77 ± 8.9	0.0001*	73 ± 7	0.023*	63 ± 2.5	0.0001*
Women (%)	66.7	80	0.164	71.2	0.538	63.8	0.644
Level of schooling (years) [median (IR)]	12.0 (1-20)	1.5 (0-6)	0.0001*	6.0 (0-18)	0.0001*	11.0 (1-19)	0.070
Subjective memory complaints [%(f)]	0	53.3	0.0001*	42.4	0.0001*	71.1	0.0001*
MoCA (mean ± SD)	27.2 ± 2	14.3±4.7	0.0001*	22.8±3.4	0.0001*	23.6 ± 3.6	0.0001*
MMSE (mean ± SD)	28.0 ± 1.5	21.2 (±4.6)	0.0001*	26.5 ±2	0.0001*	27.2 ±1.8	0.0001*

*Value-p ≤0.05 is significant

Table 3: Association among risk factors and POCFG in older adults.

Presence of factors	Without NCD Reference group	Major-NCD OR (IC95%)	Minor-NCD>70 R (IC95%)	Minor-NCD<70 OR (IC95%)
Sociodemographic				
Marital status (married)	1	1.36 (0.59-3.07)	0.78 (0.40-1.47)	0.61 (0.35-1.02)
Unqualified work	1	1.2 (1.00-1.44)	1.19 (1.02-1.38)	1.10 (0.98-1.25)
living alone	1	9.90 (3.04-32.24)	5.0 (1.73-14.84)	3.18 (1.16-8.70)
Lifestyle				
Smoking	1	0.49 (0.20-1.15)	0.56 (0.29-1.06)	0.15 (0.08-1.27)
Alcoholism	1	0.30 (0.09-0.95)	0.56 (0.27-1.14)	0.34 (0.18-0.63)
Physical activity	1	0.19 (0.04-0.23)	0.07 (0.17-0.76)	0.03 (0.02-0.07)
Comorbidity				
Type 2 Diabetes mellitus	1	3.22 (1.34-7.75)	1.70 (0.82-3.54)	7.02 (3.86-12.77)
High blood pressure	1	6.57 (2.56-16.88)	2.89 (1.52-5.50)	2.61 (1.54-4.41)
Dyslipidemia	1	1.23 (0.54-2.80)	0.89 (0.48-1.65)	2.55 (1.50-4.34)
Obesity	1	1.63 (0.68-3.87)	1.71 (0.88-3.34)	2.16 (1.24-3.73)
Heart disease	1	3.49 (1.50-8.10)	1.63 (0.83-3.16)	3.40 (1.96-5.84)
Chronic obstructive pulmonary disease	1	1.37 (0.40-4.73)	1.59 (0.62-4.06)	0.37 (1.13-1.40)
Hypothyroidism	1	7.00 (0.61-80.06)	3.06 (0.27-34.48)	4.03 (0.47-33.97)
Depression	1	-	1.07 (0.47-2.42)	0.49 (0.23-1.05)
Motor functionality				
Gait speed (m/s)	1	1.12 (0.99-1.27)	0.98 (0.05-1.13)	*
Grip strength (kg)	1	0.87 (0.81-0.94)	1.19 (1.01-1.40)	0.93 (0.93-0.99)
Frailty	1	7.79 (2.95-20.55)	2.40 (0.99-5.78)	0.30 (0.10-1.0)
Katz Index of Independence in Activities of Daily Living	1	1.97 (4.84-4.86)	1.06 (1.01-1.11)	1.50 (0.88-2.70)

OR: Odds Ratio. NCD: NeuroCognitive Disorder. C1: Cluster 1.

Main Results

Predominant objective cognitive function groups: (Table 2) shows the proportion of the clusters obtained from the analysis of the sample with the hierarchical cluster: i) Cluster 1 (C1): without Neurocognitive Disorder (NCD), or normal cognitive function; ii) Cluster 2 (C2): with major NCD, or dementia; iii) Cluster 3 (C3): with minor NCD, and iv) Cluster 4 (C4): minor NCD in OA, with C4 being the one with the highest proportion (43.2%).

Exploring the sociodemographic characteristics by age, sex and educational level for each group (Table 2), the C1 group was 71 years and the highest schooling (median=12.0, IR: 1-20). The C2 was the group with the highest age (mean 77 ± 8.9 years) and very low educational level (median=1.50 years, IR: 0-6), the

Table 4: The exploratory multivariate analysis of the association among risk factors and patterns of objective cognitive function in older adults.

	M-1			M-2			M-3		
Presence of factors	Major-NCD	Minor-NCD≥70	Minor-NCD<70	Major-NCD	Minor-NCD≥70	Minor-NCD<70	Major-NCD	Minor-NCD≥70	Minor-NCD<70
Sociodemographic									
Marital status (married)	1.18 (0.39-3.49)	0.62 (0.30-1.29)	0.47 (0.22-1.04)	1.02 (0.29-3.54)	0.55 (0.26-1.19)	0.34 (0.14-0.79)	0.55 (0.12-2.47)	0.39 (0.16-0.92)	0.27 (0.10-0.74)
Unqualified work	1.20 (0.95-1.53)	1.19 (1.01-1.39)	1.05 (0.89-1.25)	1.24 (0.94-1.62)	1.20 (1.01-1.42)	1.07 (0.89 1.29)	1.32 (0.96-1.81)	1.17 (1.00-1.39)	1.04 (0.85-1.27)
Living alone	6.65 (1.56-28.23)	5.66 (1.85-17.32)	1.19 (0.31-4.49)	3.21 (0.51-19.96)	5.21 (1.60-16.98)	2.08 (0.46 9.30)	7.58 (0.78-72.92)	6.01 (1.71-21.19)	3.38 (0.60-19.05)
Lifestyle									
Smoking	0.56 (0.17-1.81)	0.70 (0.34-1.45)	0.20 (0.08-0.48)	0.81 (0.19-3.33)	0.69 (0.32-1.51)	0.23 (0.09 0.58)	1.23 (0.21-7.05)	0.82 (0.36-1.87)	0.27 (0.09-0.99)
Alcoholism	0.61 (0.15-2.54)	0.65 (0.29-1.45)	0.66 (0.25-1.73)	0.42 (0.08-2.22)	0.61 (0.26-1.42)	0.59 (0.21 1.70)	1.03 (0.15-6.79)	0.74 (0.30-1.78)	0.56 (0.18-1.75)
Physical activity	0.10 (0.03-0.31)	0.29 (0.13-0.66)	0.04 (0.01-0.9)	0.07 (0.02-0.31)	0.30 (0.12-0.75)	0.06 (0.03 0.15)	0.08 (0.01-0.42)	0.18 (0.05-0.57)	0.05 (0.01-0.13)
Comorbidity									
Type 2 diabetes mellitus				1.19 (0.33-4.32)	0.70 (0.28-1.74)	2.77 (1.18-6.49)	2.32 (0.48-11.22)	0.62 (0.24-1.60)	3.31 (1.28-8.49)
High blood pressure				3.00 (0.77-11.63)	2.00 (0.92-4.34)	1.57 (0.66-3.72)	2.05 (0.42-9.84)	1.52 (0.66-3.48)	1.50 (0.60-3.73)
Dyslipidemia				0.47 (0.11-1.97)	0.60 (0.27-1.31)	1.16 (0.51-2.65)	0.32 (0.06-1.68)	0.66 (0.29-1.49)	0.97 (0.38-2.47)
Obesity				0.45 (0.10-1.87)	1.10 (0.48-2.52)	1.10 (0.46-2.66	0.55 (0.10-2.86)	1.43 (0.58-3.53)	1.81 (0.66-4.96)
Heartdisease				3.34 (0.92-12.08)	2.16 (0.93-4.98)	2.17 (0.92-5.12)	3.37 (0.71-15.87)	2.44 (1.00-5.97)	2.21 (0.88-5.58)
Chronic obstructive pulmonary disease				1.61 (0.24-10.77)	1.85 (0.59-5.80)	0.58 (0.10-3.93)	1.39 (0.14-13.30)	2.01 (0.62-6.48)	0.53 (0.09-2.95)
Hypothyroidism				7.76 (0.06-1021.3)	3.43 (0.15-74.57)	3.91(0.08-171.3)	6.72 (0.32-1418.3)	2.04 (0.05-76.01)	2.57(0.08-80.0)
Depression				1.62 (0.34-7.60)	1.16 (0.45-3.00)	0.26 (0.07-0.96)	1.27 (0.37-4.35)	1.18 (0.95-1.31)	0.30 (0.06-1.37)
Motor functionality									
Gaitspeed (m/s)							1.17 (0.92-1.51)	0.93 (0.87-1.00)	1.15 (0.88-1.50)
Gripstrength (kg)							0.81 (0.71-0.93)	0.93 (0.87-0.98)	0.99 (0.93-1.05)
Frailty							0.58 (0.09-3.58)	0.52 (0.13-1.98)	0.01 (0.002-0.99)
Katz Index of Independence in Activities of Daily Living							1.14 (0.23-5.57)	0.41 (0.14-1.59)	1.18 (0.41-3.43)
Likelihood	91.74	192.88	185.36	81.43	183.34	168.64	65.92	171.78	152.37

NCD: NeuroCognitive Disorder ≥70: Adults 70 years old or older < 70: Adults younger than 70 years M-1: Model 1 evaluates sociodemographic factors and lifestyle in the three groups with any NCD severity compared with the group without NCD. M-2: Model 2 evaluates the variables included in model 1 plus comorbidity factors in the three groups with any NCD severity compared with the group without NCD. M-3: Model 3 evaluates the variables included in Model 2 plus motor functionality variables in the three groups with any NCD severity compared with the group without NCD.

C3 had a mean age of 73 years ±7.0 and with a low educational level (median=6.0 years, IR: 0-18).

Finally, C4 was the youngest group (63 ± 2.5 years) and with a high educational level (median of 11 years IR: 1-19).The SCM (Table 2), in the cluster without NCD or normal cognitive function global, had zero percent and the group with the highest SCM was C-4 (71.1%). Although C2 and C3 had a lower proportion than C4, the proportion in both was high (53% and 42%).

Cognitive function with MMSE and MoCA: In Table 2, the scores for C1, with MoCA and MMSE were high and showed intact or normal cognitive function [average 27.2 (±2.0) and 28.0 (±1.5) respectively], so it was considered without-NCD and the reference group. The lowest objective cognitive function with MMSE and MoCA was for C2; therefore, this group was

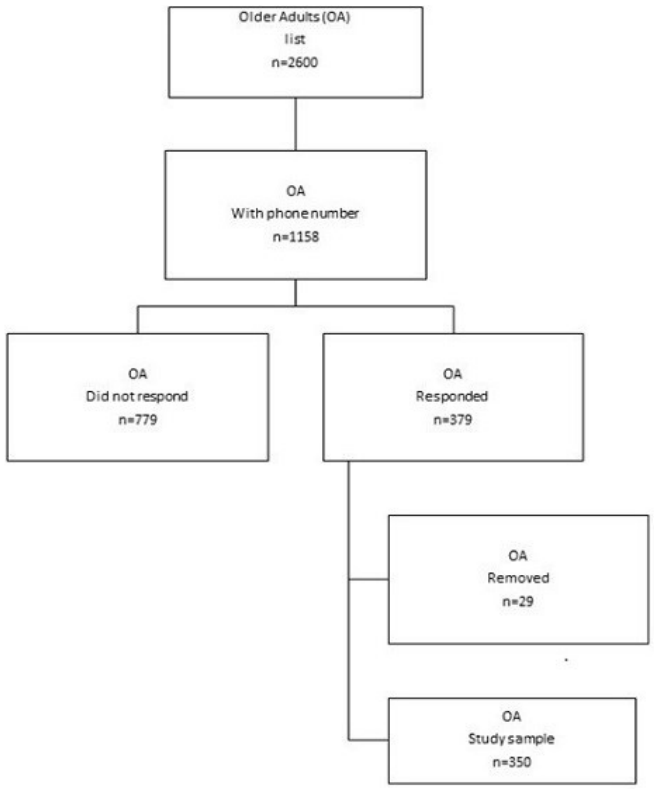

Figure 1: Sample Selection Flow Chart. OA: Older Adult.

considered with a major neurocognitive disorder (major-NCD). Although, the C3 had a mean MMSE score of 26.5 (±2), which corresponded to normal cognitive function [16], but the mean MoCA score was 22.8 (±3.4); thus, this group was considered to have mild cognitive impairment in advanced age (minor-NCD>70). Finally, C4 had a high score for MMSE= 27.2 (±1.8) and a low score for MoCA= 23.6 (±3.6), similar to the C3 group; but with younger age; then, C4was considered to have mild cognitive impairment, but due to age, of early onset (minor-NCD <70).

Association of predominant objective cognitive function groups with lifestyle, comorbidity and motor functionality as risk factors: Table 3 shows the association among the POCFG and lifestyle, comorbidity and motor function risk factors in OA, considering the C1 group with normal cognitive function as the reference group. Sociodemographic risk factors having an unqualified occupation and living alone were consistently present among the three POCFG with any NCD severity, with a high strength of association (Table 3). Conversely, physical activity was a protective factor for the three POCFG with any NCD severity, ranging from 1.1 to 33.3 times against the probability of presenting cognitive deterioration in adults with physical activity compared to those without physical activity (Table 3). The risk factors of comorbidity for major-NCD were DM2 and high blood pressure, while for minor-NCD >70 years only was the high blood pressure. Interestingly, minor-NCD <70 years, was the group with the highest number of associated comorbidities, high blood pressure, dyslipidemia, obesity, heart disease and hypothyroidism.

Regarding factors from motor functionality, major NCD had the following significant risk factors: decreased gait speed, frailty and alteration of activities of daily living, whereas grip strength was a protection factor. For the minor NCD>70 years, the risk factors were frailty and alteration of activities of daily living. Finally, for the minor NCD<70 years, grip strength was the only associated factor and it was protective.

The exploratory multivariate analyses of the sociodemographic, lifestyle, comorbidity and motor function variables were evaluated as associated risk factors are found in (Table 4). In Model 1 (sociodemographic factors and lifestyle) for major-NCD and minor-NCD ≥70 years, unqualified work and living alone remained as associated factors, but these factors were not significant for minor NCD <70 years group. However, in all three groups with any NCD severity, the physical activity continued as a protection factor.

In Model 2, where comorbidity variables were added, in the major-NCD group, sociodemographic and lifestyle factors were no longer statistically significant risk factors, but physical activity remained as a protective factor. In minor–NCD >70 years group, unqualified work and living alone remained as risk factors and, similarly to Model 1 and in the previous group, physical activity remained as protection factor. For minor-NCD <70 years group, comorbidity DM2 was a risk factor, in addition to physical activity, marital status married was associated as a protection factor.

In Model 3, the motor functionality variables were added to the previous model; in major NCD group, there were no longer statistical association with risk factors, but physical activity and grip strength remained as a protection factor. Minor–NCD ≥70 years group preserved the association with the sociodemographic unqualified work, living alone as risk factors, but heart disease was added as a risk factor. In the same group marital status married was added as protection factor and physical activity continued with its beneficial effect. Finally, Minor-NCD <70 years group remained with the same associated factors as Model 2.

Regarding the likelihood values of the exploratory multivariate analysis models, major-NCD had the lowest similarity values among the other groups, while the minor-NCD <70 years group and the minor-NCD≥70 years group had the highest values; that is, the factors highly explain the screening stratification of minor-NCD ≥ 70 years group and minor-NCD <70 years group, compared with the without-NCD group.

Discussion

Key Results

This study shows evidence of the association among the POCFG and the risk and protective factors from sociodemographic, lifestyle, comorbidity, and motor function variables in OA living in the community. This is relevant because those factors can be affordable, fast and easily identified. Present epidemiological approach considered the characterization of the POCFG groups by the following: i) subjective and objective cognitive function, age, sex and level of education, ii) risk factors and iii) likelihood.

Those factors can provide information for community risk, and interventions aimed at preventing dementia on a large scale. The usefulness of present factors to characterize patterns and validate them will also make it possible to identify groups at risk of dementia in whom prevention is still possible.

The limitations of the study were that other known lifestyle factors such as sleep patterns and diet were not evaluated, as well as aspects of anxiety and stress. Regarding objective cognitive function, neuropsychological tests were not evaluated.

Interpretation and Generalizability

The cluster analysis allowed characterize four groups, which

had a similar proportion to the reported clinical groups to dementia and MCI. The other major-NCD group (8.5%) had a proportion within the published range for dementia in Latin America (4.4%-8.4%) and Mexico [8.4%] [1]. Regarding the two groups with MCI, one of them was older than 70 years (minor-NCD >70) and their proportion was 18.8%, a figure contained within the worldwide range prevalence of MCI [6%-30%] [21]. Other group with MCI but younger than 70 years (minor NCD<70), presented the highest number of comorbidities and represented a higher proportion of the sample with SMC (71.1%) compared to other reported [21].

Age, Sex, and Socioeconomic Level

In this study of the exploration of grouping the predominant objective cognitive function in OA living in the community; it was essential to include factors such as age, sex and level of education for the differentiation and characterization of the groups.

Moreover, comorbidity and age are independent factors of increased vascular risk, mainly due to cerebrovascular disease and neurodegenerative processes [22,23]. The risk of dementia in younger adults due to vascular risk is associated with the presence of comorbidities such as diabetes mellitus, hypertension, obesity, heart disease, etc. [23]. In present study, it was possible to discriminate two groups by age the minor NCD <70 years and minor-NCD ≥70 years.

From a sex perspective, in women, in addition to neurodegeneration, the stress factor is added, as well as a high level of smoking, which are factors that affect their cardiovascular health, causing problems such as coronary disease or heart failure [23]. In men, the risk is more related to a history of neurodegeneration such as cerebrovascular disease, Parkinson's, depressive disorders, or hypertension [23]. For this study, there were a higher proportion of women attended in the primary care units, and it is documented that women are the ones who most demand health services [24]. Despite of this, women presented higher proportion of patterns of lower cognitive function.

Low level of education is a risk factor for dementia that occurs at an early age [6]. The method for grouping or classification by similarities by cluster has been used in research for the study of dementia prognosis, which has provided more precise results when risk factors are included [25,22]. In this study, the following facts were distinguished: i) a group of people with an average age of 70 years, a high level of education, and normal global cognitive function. It is possible that this group has a higher cognitive reserve, where more years of education and holding an occupation are protective factors for dementia.

This may compensate for possible brain damage frequently related to aging, so this group has been considered a reference. The group of OA with an average age of 77 years had the lowest educational level and low-global cognitive function. Due to these characteristics, a dementia pattern was considered, either due to vascular or neurodegenerative pathology related to aging [26]. iii) Two groups with MCI, where one had an average age of 73 years and low schooling, and the second group, the youngest with an average age of 63 years and an education of 11 years. In these last two groups, the first could be explained by age, with biological ageing, and the second by living with pathological changes related to chronic diseases and/or fasting pathological ageing.

SCM was another characteristic that was considered in the grouping, and contrasting them with a group with normal cognitive function without SCM. In prospective studies, it has been reported that people with SCM have a 14% chance of MCI [16] and a 27%-30% chance of dementia [16] a while the risk of MCI is two to three times higher [23] and the risk for dementia 7-20 times higher. In our study, the minor-NCD <70 group showed the highest proportion of SCM; this could be associated with the previously mentioned high comorbidity. More important is to point out the younger average age in minor-NCD <70 with respect to normal global cognitive function group, which emits a signal of dementia risk in the following years and is a group in whom effective interventions should be initiated to prevent this condition.

In present study, the MMSE score was able to distinguish the population whit dementia (MMSE=21.2), but not for people with mild cognitive impairment, since the values were in the reference range (minor NCD>70=26 and minor NCD<70=28). In contrast, the evaluation of cognitive function with MoCA, a screening test that evaluates the cognitive domains, it was possible to distinguish the alteration between memory and other domains in the groups with MCI, due to their low levels.

Association with Lifestyle Factors, Comorbidity and Motor Functionality

Modern life is a context that is often antagonistic or risky to the health and quality of life of OA, given that they are exposed to conditions such as poor diets, barriers to physical activity, exposure to smoking, conditions of social isolation and discomfort for restful sleep [5], known risk factors for dementia due to inadequate lifestyles.

This situation favors the consumption of inappropriate foods, increased smoking, physical inactivity and depression, which generates a vicious circle against healthy ageing [27].

In contrast, positive or healthy lifestyle factors have been related to more functional ageing, because most of them allow metabolic control and avoiding weight gain. In studies where interventions have been carried out to implement healthy lifestyles, it has been verified that these interventions give off emotions of happiness and favor social networks; both show long-range of health multiplier effects with successful ageing; that is, with less cognitive impairment and greater functionality-independence [27,28].

Physical activity is not only a protector against dementia, but it can also resolve or mitigate multiple diseases [29,30]. In this study, physical activity was a protective factor for any group with impaired cognitive function. In present study, was remarkable the high frequency of inactivity in the minor-NCD <70 group; therefore, its implementation is fundamental in the prevention in early stages of dementia.

Other factors studied related to global cognitive function were slower walking speed and decreased grip strength. Both were related to early symptoms of dementia, possible due to cognitive-motor impairment [31]. In our analysis, it was impossible to relate the decrease in gait speed with belonging to any group formed, but the higher grip strength was a protection factor in the major and minor NCD>70 groups. It is likely that these subjects, although have low values of cognitive function, may be still in preclinical stages because there is a relationship between lower gait speed and decreased grip strength (as determinants of physical frailty, sarcopenia, and cognitive impair-

ment and dementia).

Likelihood of Lifestyle Factors

In our study, saturated multivariate models were made to obtain the likelihood values, where the minor NCD>70 group had higher likelihood values with significance in sociodemographic factors (age, sex and level of education), lifestyle and functionality. A relevant fact is that it was a group in which comorbidity does not explain cognitive function; it is possible that the OA in this group are survivors of chronic diseases.

The minor-NCD <70 group had slightly lower likelihood values than the minor-NCD >70, since comorbidity was a more important factor than sociodemographic factors, lifestyle and functionality. The modifiable preventive factors derived from present analysis may be improved in OA with the multidisciplinary participation of the family doctor, dentistry, social work, geriatrics, and nursing. The group with the lowest likelihood values was the one with possibly dementia cognitive function, probably this group contains a higher genetic load for dementia [6].

The risk factors for dementia found in the lifestyles of our sample are low education, high blood pressure, social isolation, physical inactivity and DM. These are factors that can impact in the prevention of dementias, since the probability of reducing the incidence up to 40%, has been reported [6].

Association studies between lifestyle factors and cognitive function are important in public health because they allow estimating possible actions to prevent dementia, point out specific groups for possible specific interventions, favor times of greater opportunity or impact, and they focus on areas of greater preventive opportunity [32].

Changes from negative to healthy lifestyles are alternatives for preventing modifiable risk factors for dementia [32]. Additionally, they are optimal interventions with high public impact in low- and middle-income countries [4].

The programs must be adjusted to the general health of the older persons with surveillance measures by qualified personnel, preferably in collective activities, which favor their health by avoiding isolation and depression [29]. Physical activity is a factor highly related to improvements in nutrition, socialization, sleep and emotional well-being [29,32].

Longitudinal studies of these patterns will be future investigations allowing a better understanding of the participation of lifestyle factors and dementia, as well as the investigation of prognostic clinical characteristics and biomarkers at the population level.

Conclusions

There was an association between lifestyle, comorbidity, protective motor function as risk factors with the predominant Objective Cognitive Function Groups.

List of Abbreviations

Activities of daily life: ADL; Body mass index: BMI; Diabetes mellitus: DM2; Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition: DSM-5; Geriatric depression Scale of Yessavage: GDS-15; Mild cognitive impairment: MCI; Mini-Mental State Examination: MMSE; Montreal Cognitive Assessment: MoCA; NeuroCognitive Disorder: NCD; Odds ratio: OR; Older adults: OA; Predominant Objective Cognitive Function Groups: POCFG; Subjective memory complaint: SCM.

Supplementary Information

Additional file 1: Supporting information Table 1: Checklist for reports of observational studies STROBE Statement.

Ethics Approval and Consent to Participate

Registered with the National Commission for Scientific Research: 2018-785-0958.

Competing Interests

The researchers listed below declare that there is no conflict of interest in conducting this research protocol.

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