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Original article

Association between current smoking and cognitive impairment depends on age: A cross-sectional study in Xi'an, China☆

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ABSTRACT

Background: Cigarette smoking is a modifiable risk factor for cognitive impairment, while the relationship between current smoking and cognitive impairment is not fully understood. The objectives were to identify a possible association between current smoking and cognitive impairment depending on age in the Chinese rural population.
Methods: Data for the study consisted of 1782 participants (40 years and older) who lived in a rural village in the vicinity of Xi'an, China. Data about smoking history and cognitive function were collected. Cognitive function was scored by the Mini-Mental State Examination. The effect of age on the relationship between current smoking and cognitive impairment was analyzed with interaction and stratified analysis by logistic regression models.
Results: Interaction analysis showed that current smoking is positively related with cognitive impairment (odds ratio [OR] = 9.067; 95% confidence interval [95% CI] 1.305–62.979; $P = 0.026$). However, the interaction term, age by current smoking, is negatively related with cognitive impairment (OR = 0.969; 95%CI 0.939–0.999; $P = 0.045$). Stratified logistic regression showed that in the 40–65 years of age sublayer, OR of current smoking is 1.966 ($P = 0.044$), whereas in the >65 years of age sublayer, the OR is 0.470 ($P = 0.130$). This means that the association between current smoking and cognitive impairment with age might be positive (OR > 1) in lower age sublayers, but no significant difference in higher age sublayers.
Conclusions: In conclusion, current smoking might be positively associated with cognitive impairment in the middle-aged but the relationship declines with increasing age.
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Asociación entre el tabaquismo actual y el deterioro cognitivo y su relación con la edad: estudio transversal realizado en Xi'an (China)

Palabras clave:
Tabaquismo actual
Deterioro cognitivo
Edad
Estudio transversal

RESUMEN

Antecedentes: El consumo de tabaco es un factor de riesgo modificable para el deterioro cognitivo, no entendiéndose plenamente la relación entre dichas situaciones. El objetivo de este trabajo fue identificar la posible asociación entre el consumo actual de tabaco y el deterioro cognitivo, dependiendo de la edad, en la población rural de China.
Métodos: El estudio incluyó a 1.782 participantes (de 40 años de edad o más) que vivían en un pueblo rural de las cercanías de Xi'an (China). Se recogieron datos acerca del historial de consumo de tabaco y la función cognitiva. La función cognitiva se puntuó mediante la escala *Mini-Mental State Examination*. El efecto de la edad en la relación entre el consumo de tabaco actual y el deterioro cognitivo se analizó mediante análisis de interacción y estratificación, utilizando modelos de regresión logística.

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Resultados: El análisis de interacción reflejó que el consumo de tabaco actual guarda una relación positiva con el deterioro cognitivo (*odds ratio* [OR] = 9,067; intervalo de confianza del 95% [IC 95%] 1,3056-2,979; p = 0,026). Sin embargo, el plazo de interacción y la edad del tabaquismo actual guardan una relación negativa con el deterioro cognitivo (OR = 0,969; IC 95% 0,939-0,999; p = 0,045). La regresión logística estratificada reflejó que en el subestrato de 40 a 65 años, la OR del tabaquismo actual es de 1,966 (p = 0,044), mientras que en el subestrato >65 años, la OR es de 0,470 (p = 0,130). Esto significa que la asociación entre el tabaquismo actual y el deterioro cognitivo con la edad podría ser positiva (OR > 1) en los subestratos de menor edad, aunque no existe una diferencia significativa en subestratos de mayor edad.
Conclusiones: En conclusión, el tabaquismo actual podría estar positivamente asociado al deterioro cognitivo en la edad mediana, aunque dicha relación disminuye con el incremento de la edad.
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Introduction

Cognitive impairment means various dysfunctions of intellectual activity. As the core symptom of early dementia, cognitive impairment is being paid increasing attention.[1] The cause of cognitive impairment is indeterminate; there is no effective treatment. Therefore, it is important to identify modifiable risk factors contributing to cognitive decline, such as cigarette smoking.

Cigarette smoking is closely related to pulmonary, cardiovascular, and cerebrovascular diseases.[2] Addiction to cigarettes is a serious problem in public health. The association between cigarette smoking and cognitive impairment still needs clarification, as previous studies have submitted diverse results. The survey follow-up with three interviews over a 4-year period of subjects aged 74 years and older in the city of Cleveland does not confirm that there is an inverse relationship between smoking and cognitive impairment.[3] The analysis from the Sydney Older Persons Study suggested no associations were found between smoking and dementia or Alzheimer's disease in the very elderly, but it could not discount a role at younger ages.[4] Smoking seems to be a prospective risk factor for incident cognitive impairment in a 1-year prospective population based cohort study of all residents aged 65 or over in the electoral ward of Gospel Oak in London.[5] One study, consisting of 2553 adult Malaysians aged 60 years and older, indicated a negative association between cigarette smoking and cognitive impairment.[6] Furthermore, the relationship between cigarette smoking and cognitive impairment seems to be age-dependent.[7,8]

In previous studies, data from the Chinese, especially in rural areas, are lacking. The population in Chinese rural areas has their own special characteristics, for instance, low income level, low education level, poor health consciousness, and so on. In view of this, the relationship between current smoking and cognitive impairment in Chinese rural areas is worthy to study. The aim of this study was to identify a possible association between current smoking and cognitive impairment dependent on age in the Chinese rural population.

Materials and methods

Study participants

Data for this cross-sectional study were drawn from a survey entitled "*Relationship between hypertension and cognitive impairment*". The study was approved by the Medical Ethics Committee of the First Affiliated Hospital of Xi'an Jiaotong University. Subjects were inhabitants living in a rural village in the vicinity of Xi'an, China. Face-to-face interviews were conducted from October 8, 2014, to March 30, 2015. Our inclusion criteria were (1) 40 years and older; (2) permanent resident of the village who lived there for more than 3 years; and (3) agreed to participate the research and has completed the written informed consent and questionnaire survey. The people who were suffering from medical conditions that could interfere with cognitive function were excluded; the people who quit smoking, a total of 17 people, were also excluded. The protocol is shown in Fig. 1.

Cognitive evaluation

Cognitive function was assessed with Mini-Mental State Examination (MMSE) in a quiet room by examiners who accepted uniform training. The boundary score of MMSE was defined as $\leq$17 (illiteracy), $\leq$20 (primary school), and $\leq$24 (middle school and higher).[9]

Smoking history

Cigarette smoking was defined by answers to the following questions: Do you smoke cigarettes regularly at the present time? How many cigarettes did you smoke in a day? How long was smoking duration? Have you ever smoked cigarettes? Based on the responses, subjects were classified into three categories: current smokers, never smokers, and former smokers (quit smoking at least 6 months previously). It should be noted that the response rates of smoking duration are low; for this reason, we could not estimate the duration or total amount of smoking.

Covariates

The general condition inventory is comprised of gender, age, education level, lifestyle (cigarette smoking and alcohol habits), and medical history (hypertension, diabetes, coronary heart disease, and dyslipidemia). Physical examination and biochemical tests were tested by the biochemical laboratory of the First Affiliated Hospital of Xi'an Jiaotong University.

Statistical analysis

The data of the subjects were reported as means $\pm$ standard deviations for approximately normal distributed continuous variables, median (25% percentile, 75% percentile) for severe skewed continuous variables, and number (percentages) for categorical variables, respectively. Statistical analysis was performed with the SPSS 13.0 software package. The *P*-value for statistical tests was two-tailed and less than 0.05, which reflects a significant difference. We first explored the univariate associations of cognitive impairment with all exposures and potential confounders using *t* tests for normal or approximately normal distributed variables, χ^2 tests for categorical variables, and rank tests for severe skewed variables. In multivariate analysis, ORs and 95%CIs of cigarette smoking were then calculated. In logistic regression models, cognitive impairment was dependent variable and current smoking and confounding factors were independent variables. Interaction analysis and stratified analysis were applied to understand the effect of age on the relationship between cigarette smoking and cognitive impairment.

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