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Prevalence and incidence of cognitive impairment in older adults: associations with physical activity at leisure

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Abstract

Objective: Describing the prevalence and incidence of cognitive impairment in older adults, considering the isolated and combined presence of leisure-time physical activities, hypertension, and obesity. *Methods:* An observational, analytical, cohort study was conducted based on the data records of baseline (2008-2009) and follow-up (2016-2017) from the Campinas FIBRA Study. Screening for dementia and self-report measures concerning the number of weekly hours of low and moderate levels of leisure-time physical activities, hypertension, and nutritional status based on the body mass index (BMI) were applied. *Results:* There were 394 aged participants; 71.8% were female and 74.4% had less than four years of formal education. The mean age at the baseline was 72.8±5.3 years old, and at follow-up was 81.4±4.8. At baseline, the most prevalent concurrent conditions were physical inactivity and hypertension (21.5%), and the least prevalent were physical inactivity, obesity, hypertension and cognitive deficit (0.6%). Associations were observed between physical inactivity at follow-up, or for both measurement periods, and cognitive impairment at follow-up. Inactive participants at the baseline showed a higher incidence ratio of cognitive impairment at follow-up, adjusted for sex, age, education, nutritional status and hypertension (RI=2.27; 95%CI: 1.49-3.45; p<0.001). *Conclusion:* Prevalence and incidence of cognitive deficit mostly reflected the influence of low levels of leisure-time physical activity at baseline and follow-up.

Keywords*:* Cognition. Exercise. Nutritional Status. Hypertension. Older Adults.

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INTRODUCTION

Changes in cognitive status are more likely in those aged 70 and 80 years old, when functional capacity tends to decline, cognitive losses become more likely, the manifestation of chronic degenerative diseases are more evident, and interindividual differences more noticeable than in early old age[1].

Changes in cognitive status in old age result from a multifactorial process, in which non-modifiable determinants, such as age and genetics, act together with risk factors arising from the way people live their lives and the choices they make, depending on their beliefs, possibilities, social arrangements and education[2,3]. Diabetes mellitus, obesity, systemic arterial hypertension and depression; smoking and physical inactivity, and a lower education level, increase the risk of cognitive decline in old age[4]. About one third of cases of dementia can be avoided with proper management of determinants that include physical activity and diet management, among other modifiable factors, through healthy habits and self-care[2].

The term physical activity refers to a wide class of voluntary actions performed by the skeletal muscles, generating higher caloric expenditure than that observed when the body is at rest[5]. Within the scope of epidemiological research in geriatrics, measures of physical activity are established through surveys of the engagement of older adults in actions that occur in different spaces and at different times, following different logics and intentions. Among them are utilitarian physical activities, subordinated to specific objectives, such as those performed in work situations, while commuting and during domestic hygiene. There are non-utilitarian physical activities, but subordinated to a purpose, which are carried out in leisure situations. Among these are physical exercises and sports, the former characterized by planning, structuring and systematization associated with the purpose of maintaining or improving physical condition. Sports respond to pre-established, common sense rules, and their main objective is participation, but they can also be aimed at physical conditioning[6].

There is great interest in creating indicators of people's involvement in practices that require body movement and physical effort and are carried out in free or leisure time. They are associated with different values and meanings, mainly related to health, socialization and the improvement of physical conditioning[5,6]. There is evidence of a positive association between high levels of leisure-time physical activity and a decrease in the risk of cognitive decline in old age[7-10], supporting the notion that the regular practice of these activities is a relevant modifiable risk factor for maintaining cognitive status.

Unfortunately, the engagement of older adults in leisure-time physical activities tends to decline[5,11,12], together with functionality[12] and living space[11,12]. Likewise, systemic arterial hypertension (SAH) and obesity can act as barriers to engaging in leisure-time physical activities[13] and cognitive health[14,15]. The impact of these changes is felt in the physical[3,11], cognitive[14,15] and psychosocial[3] spheres, affecting the quality of life of older adults[17] and interfering in health system costs and impacting the economy of families[11,14].

Brazilian literature on the effects of the isolated or combined presence of leisure-time physical activity levels, hypertension and obesity on the cognitive status of older adults is scarce. The theme is important considering that the three conditions act in determining the cognitive status in adult life and in old age and their control integrates an arsenal of resources for dementia prevention. This study aimed to describe the prevalence and incidence of cognitive impairment in older adults, considering the isolated or concurrent presence of leisure-time physical activities, SAH and obesity, while also analyzing the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment in two measurement times.

METHODS

The research adopted an observational, analytical, cohort design, based on baseline and follow-up records from the electronic database of the Frailty in Brazilian Elderly Study (FIBRA Campinas). Its participants were part of the sample of a multicenter, population-based study on frailty in older adults, with baseline and follow-up measurements taken in 2008 and 2009 and 2016 and 2017, respectively.

At baseline, the sample consisted of 900 individuals aged 65 and over, recruited by trained personnel, in family households and in points of flow of older adults located in 90 census tracts drawn at random, from all census units in the urban area from the municipality of Campinas, SP, Brazil. Quotas of men and women aged 65 to 69, 70 to 74, 75 to 79 and 80 and over, to be recruited to represent the older adult population were estimated, with a 4% margin of error. The follow-up sample comprised 394 older adults aged 72 years or over, recruited from addresses collected at baseline and interviewed in 2016 and 2017. Among these, 129 (14.3%) had died and 377 (42.9%) were considered as sample losses, because they could not be located (60.2%) or because the area in which they lived offered risk to the interviewers (0.9%), refusal to participate (31.8%) or withdrawal (1.8%), and exclusion due to the research criteria (5.3%).

The eligibility criteria for the baseline sample were 65 years of age or over and permanently residing in the census tract and household. Older adults who presented the following were excluded: severe sensory and communication problems; motor and language sequelae resulting from stroke; restricted to bed or a wheelchair; advanced-stage Parkinson's disease; cognitive impairment suggestive of dementia; cancer and undergoing chemotherapy treatment. In the follow-up, older adults who declared not knowing or not wanting to respond to items of the instruments used to measure the variables of interest were excluded.

The older adults were invited to participate in a single data collection session at previously scheduled dates and times: at baseline in community centers, clubs, churches, schools and basic health units; and during follow-up, at home. Details on the composition of the sample for the two phases, on recruitment and on data collection have been described in previous publications[16,17].

Verbal, clinical, and performance measurements were part of the research protocol at baseline and follow-up. Measurements of leisure-time physical activity was derived from the investigation of daily and weekly time spent practicing moderate and vigorous physical exercise, using 11 dichotomous items selected from the Minnesota Leisure Activity Questionnaire[18], which uses the level of caloric expenditure evaluated in metabolic equivalent of task (MET, where 1 MET =1 kcal/kg/h) as a criterion[6]. Activities considered as moderate, 3 to 6 METs, were: walking, cycling, ballroom dancing, gymnastics at home, hydrogymnastics, bodybuilding, and adapted volleyball. Activities considered as vigorous, more than 6 MET, were: gymnastics at a gym or club, light running, vigorous running, and swimming. For each activity performed in the last week, data on the frequency of practice and minutes per day were collected. Based on the WHO (2020) criteria, older adults who practiced 150 minutes of moderate activity or 75 minutes of vigorous activity at baseline and/or follow-up[19] were considered active. Based on these indicators, the older adults were classified into four groups: active at baseline and at follow-up (Active/Active); inactive at baseline and follow-up (Inactive/Inactive); active at baseline and inactive at follow-up (Active/Inactive); and inactive at baseline and active at follow-up (Inactive/Active).

SAH was assessed through three consecutive blood pressure measurements performed in the sitting and standing positions[20]. Older adults with systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg[21] were considered hypertensive. Obesity assessment was based on anthropometric measurements of weight and height, which were converted into body mass indexes [BMI = weight (kg)/height (m^2)] and compared with indicators of nutritional status: underweight (BMI ≤23.0 kg/m^2); normal weight (BMI >23.0 and <28.0 kg/m^2); overweight (BMI ≥28.0 and <30.0 kg/m^2) and obesity (BMI ≥30.0 kg/m^2) established by the World Health Organization[22]. Based on these values, the older adults were classified as obese (BMI ≥30.0 kg/m^2) and non-obese (other BMI values).

Cognitive status was indicated by the median scores obtained by older adults in the Mini Mental State Examination (MMSE)[23], adjusted for years of education, minus one standard deviation (17 for those who never attended school, 22 for those with 1 to 4 years of education, 24 for those with 5 to 8 years, 26 for those with 9 or more years)[24]. Thus, participants were classified with or without cognitive impairment.

At the two measurement periods, the variables submitted to statistical analysis were cognitive impairment (dependent variable) and leisure-time physical activity x inactivity, sex, age, education, SAH and nutritional status (independent variables). Comparisons were made between prevalences using the McNemar test. The observed prevalences were used to construct two Venn diagrams: one for baseline and the other for follow-up. Chi-square tests were performed to verify the variables statistically associated with physical activity x inactivity for these two periods. Poisson regression analysis was performed at follow-up to estimate the incidence ratio of cognitive impairment, with the respective 95%CI confidence intervals. All variables were incorporated into this adjusted analysis. The results were referenced at a significance level of 5% (p<0.05).

Before the interview, all participants signed a term of free, informed consent regarding the objectives and procedures of the research, and the ethical commitments of the researchers. The research projects and the pertinent documentation were previously approved by the Research Ethics Committee of the State University of Campinas by reports 907.575 (baseline), 1.332.651 (follow-up) and 3.281.728 (this study).

RESULTS

At baseline, the participant mean age was 72.8±5.3 years old and at follow-up, it was 81.4±4.8 years old. The majority were women (71.8%) and had between 0 and 4 years of education (74.4%). Table 1 presents the baseline and follow-up percentages of older adults who were classified as: physically active or inactive; with or without SAH; eutrophic, underweight, overweight or obese; and with or without cognitive impairment suggestive of dementia. At follow-up, a significantly higher number of inactive older adults and older adults with hypertension were observed than at baseline.

Table 1. Older adults who assessed themselves as physically active or inactive during leisure time, and presented with or without cognitive impairment, hypertension, and obesity, at baseline and at follow-up. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Baseline	Follow-up	*p* value*
	n (%)	n (%)	
Leisure-time physical activity			
Active	219 (55.6)	75 (19.0)	<0.001
Inactive	175 (44.4)	319 (81.0)	
Systemic arterial hypertension			
No	184 (46.7)	144 (36.5)	<0.001
Yes	210 (53.3)	250 (63.5)	
Nutritional status**			
Eutrophic	169 (43.0)	169 (43.0)	
Underweight	55 (14.0)	75 (19.1)	0.999
Overweight	112 (28.5)	104 (26.5)	
Obese	57 (14.5)	46 (11.4)	
Cognitive deficit			
No	319 (81.0)	310 (78.7)	0.370
Yes	75 (19.0)	84 (21.3)	

*McNemar test; **Determined by body mass index (BMI).

In Figure 1, the Venn diagram presents the isolated and concurrent prevalence of hypertension, obesity, leisure-time physical inactivity and cognitive impairment at baseline. Among the older adults, 23.0% presented hypertension, 19.1% were inactive, 7.0% showed cognitive impairment, and 3.7% were obese; 21.5% were both inactive and hypertensive, 7.0% were hypertensive and showed cognitive impairment, 4.3% were obese and hypertensive, 3.0% were obese and inactive, 2.4% were inactive and showed cognitive impairment, and 0.6% were obese and showed cognitive impairment.

The same relationships observed at baseline were present at follow-up: 35.6% of the participants were inactive and hypertensive, 20.4% were inactive and 11.4% were hypertensive, inactive and presented cognitive impairment (Figure 2).

To calculate of the incidence of cognitive deficit in the follow-up, the active older adults were excluded from the baseline sample (n=75), since the aim was to observe which variables were associated with a change in status, considering sex, age, education, SAH, obesity and leisure-time physical activity. Associations were observed between physical inactivity at follow-up, or for both measurement periods, and cognitive impairment at follow-up (Table 2).

According to the result of the Poisson regression model test, adjusted for the variables sex, age, level of education, nutritional status and SAH, older adults who were inactive at follow-up showed a higher incidence ratio for cognitive impairment at follow-up (Table 3).

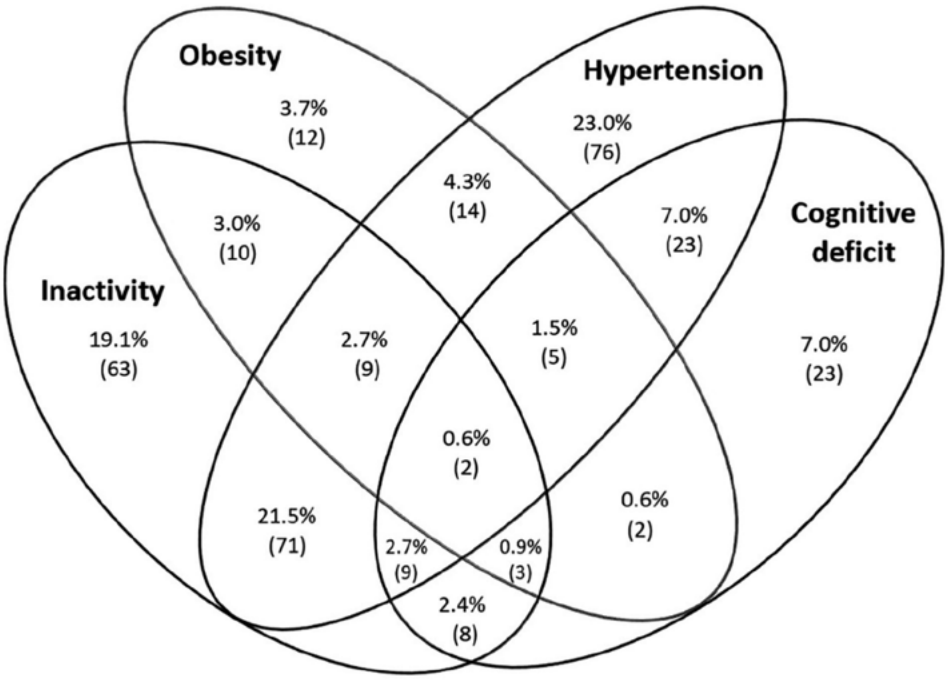

Figure 1. Venn diagram on the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment at baseline (n=330). FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

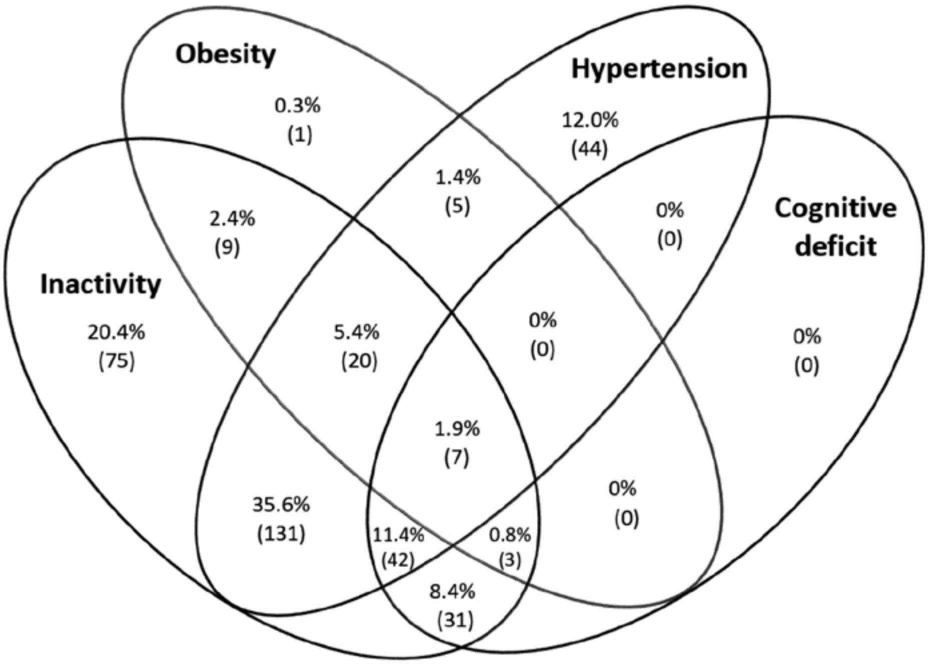

Figure 2. Venn diagram on the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment at follow-up (n=368). FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Table 2. Incidence of cognitive impairment at follow-up, considering sociodemographic variables, SAH, nutritional status and leisure-time physical activity. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	With Cognitive Impairment 264 (82.8%) n (%)	Without Cognitive Impairment 55 (17.2%) n (%)	*p* value*
Sex			
Male (95)	76 (80.0)	19 (20.0)	0.396
Female (224)	188 (84.0)	36 (16.0)	
Age			
65-69 years old (104)	86 (82.7)	18 (17.3)	
70-79 years old (183)	155 (84.7)	28 (15.3)	0.208
80 years old or over (32)	23 (71.9)	9 (28.1)	
Education			
Never attended to school (53)	40 (75.5)	13 (24.5)	
1-4 years of schooling (182)	149 (81.9)	33 (18.1)	0.101
5 or more years of schooling (84)	75 (89.3)	9 (10.7)	
Obesity			
Non-obese (273)	226 (82.8)	47 (17.2)	0.926
Obese (45)	37 (82.3)	8 (17.7)	
Leisure-time physical activity			
Active/Active or Inactive/Active (218)	190 (87.2)	28 (12.8)	**0.002**
Active/Inactive or Inactive/Inactive (101)	74 (73.3)	27 (26.7)	

*Chi-square test; statistically significant difference $p<0.05$

Table 3. Poisson regression model of cognitive impairment in the elderly over nine years, on average, considering leisure-time physical activity, sociodemographic variables, SAH and nutritional status. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Cognitive impairment IR** (95%CI)	*p* value*
Leisure-time physical activity		
Active/Active and Inactive/Active (ref)	1.00	-----
Active/Inactive and Inactive/Inactive	2.04 (1.20-3.50)	**<0.001**
Sex		
Male (ref)	1.00	----
Female	0.83 (0.47-1.48)	0.545
Education		
Never attended to school (ref)	1.00	----
1-4 years of schooling	0.69 (0.35-1.35)	0.285
5 years or more of schooling	0.45 (0.19-1.07)	0.073
Age		
65-69 years old (ref)	1.00	----
70-79 years old	0.89 (0.49-1.64)	0.728
80 years old or over	1.44 (0.63-3.28)	0.375
SAH***		
Non-hypertensive (ref)	1.00	----
Hypertensive	1.14 (0.65-2.00)	0.951
Nutritional status, determined by BMI****		
Non-obese (ref)	1.00	----
Obese	0.23 (0.59-0.96)	0.045

* Poisson regression; ** Incidence ratio; *** SAH, systemic arterial hypertension; **** BMI, body mass index.

DISCUSSION

At baseline and follow-up, low leisure-time physical activity and SAH were the most prevalent conditions, while obesity and cognitive impairment were the least prevalent. The incidence of cognitive impairment at follow-up was higher among physically inactive older adults than among those who were physically active. The prevalence of obesity did not increase during follow-up, in contrast to that observed for low weight, possibly due to the presence of older adults in the sample. However, a significant association was determined between obesity and cognitive impairment.

From baseline to follow-up, a significant increase was observed for physically inactive older adults in leisure situations. A literature review which analyzed data from several countries showed that the inactivity rate increases among adults over 70 years old, affecting between 35% and 80% of the population[26]. In this study, the number of inactive older adults varied in a similar manner, increasing from 44.4% to 81%. The larger number of inactive people was probably motivated by the loss of functional and cognitive abilities and the emergence of limitations associated with these. Fear of falls and injuries and a lack of motivation and family support, together with the scarcity of information on exercises separate older adults from the practice and make them more vulnerable to chronic diseases, disability and inactivity[3,27].

Data from this study indicate that SAH showed an increased prevalence at follow-up, when 64.4% of older adults were hypertensive. These data are comparable with other similar national population studies[28,29], and in the international scenario, similar data were obtained for the population over 70 years of age[26,30]. The practice of physical exercises and the presence of SAH has a reverse causality relation, as regularly active individuals show lower rates of cardiovascular diseases, while non-practitioners are more likely to present these types of disease[30,31]. The practice of physical activity is closely linked to good cardiovascular health and lower rates of disease. In this research, the concurrent prevalence of SAH and physical inactivity increased during follow-up. In contrast, the implementation of an active routine helps control blood pressure, improves cardiovascular function and protects cognitive function[1,30].

The increase in the concomitant occurrence of the conditions studied at follow-up, compared with baseline, can be associated with the decrease in functional reserves resulting from aging, in combination with lifestyle[13]. One Brazilian study that analyzed the patterns of multimorbidity in individuals aged 50 years old or over, associated the occurrence of two or more diseases with age, a risk factor for the coexistence of several chronic health conditions[29]. The same result was obtained in a clinical[1] and an epidemiological study[28], in which 80% of adults over 70 years old presented at least two chronic conditions. The coexistence of these factors can influence other systems, trigger comorbidities, increase systemic inflammation, and impair physical and cognitive health[26,30]. Physical and cognitive losses are often associated with multimorbidities, disabilities and inactivity[27].

Cognitive decline was mainly influenced by the condition of physical inactivity: older adults who were physically inactive at baseline and at follow-up were 2.27 times more likely to present cognitive impairment than those who exercised at some point. The literature indicates that physical inactivity is associated with worse cognitive health and a greater probability of developing dementia and Alzheimer's disease[14]. Inactive older adults have a 20 to 30% greater risk of developing cognitive losses than those who exercise[32]. In contrast, physical activity can help improve cognitive function and, consequently, delay the progression of cognitive impairment, even in older adults who practice activities below recommended levels[33].

Participants active at baseline and inactive at follow-up were more likely to score for cognitive impairment at follow-up. There is evidence that discontinuing exercise in a group of older adults for just 10 days resulted in reduced hippocampal blood flow, a predictor of cognitive impairment in the long-term[34]. From such findings, we can infer the importance of regular and uninterrupted practice of exercises to maintain good cognitive health.

A study involving 3,752 adults and older adults, using a methodology similar to that developed by this research, tracked the participants' physical activity for 12 years and classified the individuals into four groups: active in the pre- and post-test periods; inactive in both these periods; active in the pre-test period, and inactive in the post-test period; and inactive in the pre-test period and active in the post-test period[31]. They observed that the groups formed by older adults who were inactive in the pre- and post-test periods, and those who were active in the pre-test and inactive in the post-test period, were more likely to present chronic diseases and had worse general health status, which were significantly associated with cognitive impairment. These results suggest that long-term physical inactivity can harm physical health, functionality and cognition.

The difficulty in implementing an exercise routine, in combination with symptoms of illness, disability and use of medication[3,26] increases inactivity and exposes older adults to the risks of developing cognitive impairment and comorbidities[32]. Even though they do not present a consensus regarding the ideal quality and quantity of ideal exercises for the older adult population, such studies converge in their appraisal of this practice, as a great ally in the fight against cognitive decline and physical inactivity[31]. The practice of physical exercises is inherent to good cognitive health, prevents chronic diseases and contributes to a process of successful aging. Despite presenting practical limitations, it is still a simple, effective, lower cost action for older adults and the health system than the use of medication. Over the years, readjusting and planning activities to maintain the ideal level of demand is important to avoid discouragement and discontinuation.

At follow-up, obesity was shown to be a protective factor for cognition among the oldest participants, a finding also observed in the systematic review by Dall and Hassing[35]. Although this cannot be considered indicative of a cause and effect relationship, this data suggests the presence of greater cognitive reserve and more robust health status in the obese older adults than in those who scored for frailty, sarcopenia, low weight and associated morbidities, most of whom died earlier.

One limitation of this study is that the records obtained at two time periods separated by a relatively long interval fail to inform us about how continuous or intermittent the practice of exercises was over the years, because intermediate measures are unavailable. Another limitation stems from the fact that data on leisure-time physical activities were self-reported and were not supplemented by objective measures. The strengths of the study result from the prospective design and the fact that the follow-up sample is composed of long-lived people from a sample that was originally population and census based.

CONCLUSION

Physical inactivity represented a risk factor for cognitive decline in the sample studied. In contrast, the continuous practice of physical exercises is a tool for promoting successful aging, healthy cognition, and the prevention of chronic diseases and their consequences. More data are required to elucidate mechanisms that explain how physical exercises can facilitate improvements in these conditions in the long-term.

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