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THE INFLUENCE OF LIFESTYLE BEHAVIORS ON THE INCIDENCE OF FRAILTY

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Abstract

Background: Frailty is a clinical state defined as an increase in an individual's vulnerability to developing adverse health-related outcomes.

Objectives: We propose that healthy behaviors could lower the incidence of frailty. The aim is to describe the association between healthy behaviors (physical activity, vaccination, tobacco use, and cancer screening) and the incidence of frailty.

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Conflict of interest: The authors declare that they have no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Design: This is a secondary longitudinal analysis of the Mexican Health and Aging Study (MHAS) cohort.

Setting: MHAS is a population-based cohort, of community-dwelling Mexican older adults. With five assessments currently available, for purposes of this work, 2012 and 2015 waves were used.

Participants: A total of 6,087 individuals 50-year or older were included. Measurements: Frailty was defined using a 39-item frailty index. Healthy behaviors were assessed with questions available in MHAS. Individuals without frailty in 2012 were followed-up three years in order to determine their frailty incidence, and its association with healthy behaviors. Multivariate logistic regression models were used to assess the odds of frailty occurring according to the four health-related behaviors mentioned above.

Results: At baseline (2012), 55.2% of the subjects were male, the mean age was 62.2 (SD ± 8.5) years old. The overall incidence (2015) of frailty was 37.8%. Older adults physically active had a lower incidence of frailty (48.9% vs. 42.2%, $p < 0.0001$). Of the activities assessed in the adjusted multivariate models, physical activity was the only variable that was independently associated with a lower risk of frailty (odds ratio: 0.79, 95% confidence interval 0.71–0.88, $p < 0.001$).

Conclusions: Physically active older adults had a lower 3-year incidence of frailty even after adjusting for confounding variables. Increasing physical activity could therefore represent a strategy for reducing the incidence of frailty. Other so-called healthy behaviors were not associated with incident frailty, however there is still uncertainty on the interpretation of those results.

Keywords

Frailty; age; healthy lifestyle; epidemiology of aging; healthy aging

Introduction

The aging of the human population is one of the most challenging problems in health of our times. Moreover, as the population becomes older, the prevalence and incidence of chronic diseases increases (1). Poorly controlled chronic diseases along with psychosocial factors can lead to many conditions, including frailty, disability, a lower quality of life, and increased mortality rates (2). Frailty is a geriatric condition defined as an increase in an individual's vulnerability with poor resilience that leads to the development of adverse health-related outcomes (e.g., falls, institutionalization, functional decline, and an increased use of health services) when exposed to stressful events (3). Previous studies have shown that the prevalence of frailty in Latin America is very high (4–8), when compared to other regions. Frailty is a relevant public health issue because it has multiple consequences for both individuals and society (9).

Regarding its causes, apart from biological paths, frailty has been related to socio-demographic, psychological, and lifestyle behaviors (10, 11). In particular, lifestyle behaviors (e.g., physical activity, diet, tobacco use, risk alcohol drinking, etc.), have shown amenable to be intervened and change frailty's trajectory (12). Moreover, a recent systematic review aimed at identifying factors that impact frailty (13) described a number of variables

that could represent either risk or protective factors during the development of frailty. For example, socio-demographic factors (e.g., older age or no health insurance), physical factors (e.g., obesity or functional limitations), psychological factors (e.g., depression) and biological factors (e.g., elevated levels of serum uric acid) increased the risk of developing frailty. On the other hand, lifestyle behaviors, such as a balanced diet rich in fruits and vegetables, were protective against frailty (14).

Specific lifestyle behaviors, such as physical activity, cancer screening, vaccination or smoking cessation, can play important roles in preventing frailty (12, 13, 15). In the context of active aging, they have been widely described as having a positive influence on the overall health status of older adults. However, few studies have explored the associations between frailty and these potentially protective factors; in particular in Latin American older adults. It is imperative to identify the factors associated with incidental frailty and thoroughly describe the epidemiological characteristics of frailty in order to design interventions aimed at preventing it [8, 16]. In the current study, we analyze the relationship between four lifestyle behaviors and the 3-year incidence of frailty among community-dwelling older Mexican adults.

Methods

We conducted a longitudinal analysis using data obtained during the third (2012) and fourth (2015) waves of the Mexican Health and Aging Study (MHAS), a prospective nationally representative panel study conducted in Mexico. The aims and design of the MHAS have been published elsewhere (17). Briefly, the MHAS contains a representative sample of community-dwelling Mexican adults over 50 years of age. Questionnaires from different topics, including socio-demographic characteristics, health-related conditions, accessibility to health services, cognitive performance, functional status, and financial resources, were used to interview all participants in their households.

Participants

Data were collected from 18,465 participants in 2012. In the present study, we included data collected from 6,087 subjects without frailty (see below how frailty was defined) in the third wave to assess the relationship between healthy behaviors and the incidence of frailty in 2015.

Variables

Dependent variable—Frailty was defined using the frailty index (FI), as recommended by Searle et al [18]. The FI was constructed with reference to 39 deficits in different domains: self-rated health, current health compared with prior health status (2 years), self-reported chronic diseases (hypertension, diabetes mellitus, cancer, respiratory illness, heart failure, heart attack, stroke, arthritis, falls, fractures, and visual impairment), difficulty in basic activities during daily living (ADL) and instrumental ADL (IADL), self-reported common symptoms in the previous two years (pain, fatigue, depressive symptoms, restless sleep, loneliness, sadness, lack of energy, memory loss, appetite loss, and weight loss). As previously mentioned, the FI was composed according to a standardized procedure, which

included transforming each variable into a score of 0 (deficit absent) to 1 (deficit present), including a range of possible intermediate scores. All deficit scores were added, and the total was then divided by 39 (total number of deficits in the current list) for each participant. The total scores for the FI therefore ranged from 0 (no deficit present, indicating the lowest possible frailty burden) to 1 (all deficits present, indicating the highest possible frailty burden). Older adults with an FI score of 0.21 or higher were considered frail, as previously validated in this population (19).

Healthy behaviors—Healthy behaviors were considered based on the policy framework for active aging proposed by the World Health Organization using the following questions: for screening activities for prostate (for males), breast, and cervical cancer (for females), "In the last 2 years, have you had a prostate cancer screening test/self-breast exam/pap smear?"; for smoking status, "Did you smoke in the last two years?"; for physical activity "In the last 2 years, have you exercised or performed hard physical work 3 or more times per week?"; and for vaccination, "In the past two years, have you had any of the following tests or medical procedures: Influenza vaccine and/or pneumococcal vaccine". Finally, we created a variable based on the sum of the healthy behaviors that were present in the subjects (0, 1, 2, 3 or 4), and this variable was analyzed using an ordinal statistical approach. See Supplementary Table 2 for a detailed description of the variables.

Confounding variables—Because the objective was to test the independent relationships between healthy behaviors and frailty, we adjusted our analysis for the following variables: socio-demographic variables (age, sex, marital status, financial status [self-rated], and education level [completed years in school]). We also included physician visits ("Have you visited a physician within the last 2 years?") because healthy behaviors are associated with increased exposure to health services.

Statistical analysis

Descriptive analyses are shown as frequencies and percentages for categorical variables and means and standard deviations for continuous variables. For bivariate comparative analyses, chi-square tests or Student's t-tests were used as appropriate, depending on the variable distribution. Multivariate logistic regression models were fitted to obtain an odds ratio (OR) with 95% confidence interval (CI) for the relationship between the incidence of frailty and the independent variable being tested. The results were adjusted for confounding variables and are presented as non-adjusted and adjusted models. The level of statistical significance was set at $p<0.05$. All data were analyzed using STATA 16.0 ® for Mac OS (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA).

Ethical issues

The Institutional Review Boards of the University of Texas Medical Branch, the Instituto Nacional de Estadística y Geografía and the Instituto Nacional de Salud Pública of Mexico approved this study. All study subjects signed an informed consent form. The study adhered to the ethical guidelines of the Declaration of Helsinki.

Results

Table 1 shows the characteristics of the sample population, according to frailty status. Of the total sample of 6,087 non-frail older adults, 55.2% were male, the mean age was 62.2 (SD ± 8.5) years old, and the mean years of education was 7.8 (SD ± 10.7). During the previous 2 years, a total of 72.4% of the individuals visited a physician, 69.8% had a fair to poor financial status.

Table 2 shows the results of the bivariate analysis of healthy behaviors reported: 55.6% had received a flu vaccine, 51.5% had used at least one of the included screening procedures, 46.4% had a low level of physical activity, and 83.2% had not smoked. The healthy behavior score showed that most of the sample had performed at least 3 healthy activities (53.4%). The incidence of frailty for the cohort was 37.8%. Compared to frail older adults, non-frail older adults performed more physical activities (48.9% vs. 42.2%, $p < 0.001$). There was no difference between the populations in vaccinations, medical screening activities, or the sum of the two.

Table 3 shows the results of the multivariate analyses. The unadjusted logistic regression model showed that the sum of activities (with 0 used as the reference), vaccination and screening activities were not significant predictors of frailty. Not smoking, however, increased the odds of becoming frail (OR 1.2 95% IC 1.1–1.4, $p = 0.001$), while physical activity decreased the odds (OR 0.7 95% IC 0.6–0.8, $p<0.001$). In the adjusted model, only physical activity remained significantly associated with a lower risk of developing frailty (OR 0.7 95% IC 0.7–0.8 $p <0.001$). When grouping according to the number of healthy behaviors, having 2 or 3 healthy habits was also associated with lower frailty incidence (OR 0.8, $p<0.001$). Having more than three had a border significance (OR 0.8, $p=0.08$).

Discussion

Frailty in older adults is a major public health problem and a challenge to healthcare professionals (8). Frailty exacerbates declines in physical function and predisposes individuals to several negative health-related outcomes (20). In this longitudinal analysis of the MHAS, our main finding is that being physically active in the previous two years was associated with a lower incidence of frailty three years later. Physical activity, as evaluated in our study, decreased the risk of developing frailty by 21%. In the total sample, the incidence of frailty in 2012 was 37.8%. When the population was divided into those who performed physical activity and those who did not, the group that had not performed physical activity had a higher incidence of frailty (40.6% vs. 34.4%, $p <0.001$).

The term physical activity indicates any bodily movement produced by skeletal muscles that requires energy expenditure and includes exercise, which is defined as a regularly structured program of physical activity aimed at maintaining an optimal level of fitness (21). These activities are recommended in the elderly for achieving good health and optimal physical function (22). There is evidence showing that being physically active may alter the course of many frequently occurring diseases among older adults and that physical activity and exercise are important factors that reduce overall morbidity and mortality (23).

Nevertheless, a better option for this population, especially for preventing adverse health consequences, should be maintaining a healthy status (for example, by preventing frailty) and using physical activity as an important tool to do so. Hence, physical activity should be considered a public health target and part of an important strategy aimed at preventing the onset of frailty and the numerous negative health-related outcomes that come with this condition. This is of particular importance in developing countries, such as the one (Mexico) from which data was obtained for this study, that have a shortage of specialized professionals trained to care for older adults. Physical activity has been shown to be economically and readily available, even for individuals with a high burden of disability. A sedentary lifestyle has been associated with a higher frequency of frailty (24). Our results support this notion and are consistent with other reports showing that physical activity is independently associated with delaying the onset and progression of frailty (25).

Some studies report that exercise and physical activity have the potential to prevent frailty (26). Our results support the notion that adults who perform physical activity reduce their risk of frailty. In addition, other studies have shown that physical activity and exercise are effective interventions for frailty, and this should open the door for future research (27). These findings argue against the common belief that older frail adults should be excluded from physical activity programs because they are unlikely to adhere to the program and could experience adverse events.

However, there are many barriers, both real and perceived, that represent obstacles to the adoption and maintenance of regular physical activity. In our sample, 46.4% of the people performed physical activities. Reports in the literature show that a percentage ranging from 11.7% to 77.2% of adults perform regularly physical activities. This variation is due to differences in the definitions and types of physical activity that were included in these studies (28).

It was particularly evident in our study that the development of frailty was not prevented solely by the sum of several healthy behaviors. A positive trend was observed in both the unadjusted and adjusted models, suggesting that performing more healthy behaviors had a larger impact on outcomes (29).

Smoking status in older adults (i.e. current smokers, new smokers, and past smokers) had an important effect on health-related outcomes. However, those who never smoked or were former smokers had higher odds of developing frailty when compared to current smokers; this might be due to the fact that frailer older adults not smoking may have some medical conditions that precludes them from smoking tobacco. Nevertheless, Ottenbacher et al. reported a higher incidence (operationalized with the frailty phenotype) of frailty along those who had ever smoked (30); on the one hand this could be misleading by having in the same group both current and former smokers, as stated previously; and on the other hand, even that the population is similar (i.e., Mexican Americans), health conditions along with sociocultural features are quite different between Mexico and the United States. Further analyses using other sources of data are needed to better characterize the relationship between smoking and frailty.

With regard for vaccination, a cross-sectional study performed in Mexico of 927 participants aged 70 years old or older also reported that there was no association between frailty and having an incomplete vaccination scheme (15).

Interestingly, when grouping older adults according to the number of healthy behaviors, having two or more (regardless which), was associated with a lower incidence of frailty. Having four or more had a border significance, maybe due to power issues, since that group represents only 12% of the sample. Nevertheless, it is a hint on how sum of actions could work in favor of positive outcomes in older adults, and the importance on the potential of simultaneous preventive strategies rather than isolated ones.

It is important to emphasize that our results arise from a 3-year follow-up study and may therefore not capture the long-term impact of other health-related behaviors. Nevertheless, frailty and healthy behaviors are dynamic and tend to change over short periods of time. Additional work aimed at analyzing healthy behaviors and frailty trajectories will allow us to better analyze these relationships. Another limitation of our study was the fact that the data were self-reported, and there is therefore the potential for memory bias, which can lead to lower rates of evaluated conditions. Second, it was not possible to define the type of physical activity performed by participants or its intensity and duration, and this resulted in a large range of activities being referred to as physical activities by the participants. Third, most of the subjects were asked questions about healthy behaviors performed during the previous two years but were not asked about the duration or current status of the behavior, which made it difficult to interpret some of these data. Finally, the use of a secondary analysis, in which a number of fixed variables were adjusted for, left out a number of other conditions that would have been of interest.

In spite of these limitations, our study adds to the limited body of evidence available regarding the relationship between healthy behaviors and frailty in Latin America. These data could help to better characterize groups of immigrants from these regions who currently live in other countries outside Latin America. To perform physical activity three times or more per week provides a benefit in terms of decreasing the 3-year incidence of frailty. These results are very important and need to be conveyed to the policy makers who establish public health strategies. Physical activity has the potential to improve the quality of life of the aging population in the study region. Further research is required to determine how to implement the strategies that can best achieve these interventions in all populations and prevent negative outcomes.

The results of the present study show that there is a relationship between physical activity and a lower incidence of frailty within a period of 3 years. These findings should lead to the generation of proposals aimed at formulating new studies that can support the creation of public policies aimed at preventing the appearance of frailty in the elderly.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Descriptive data from non-frail subjects in 2012

Variable	n (%) or mean ± SD
Total	6087 (100)
Age	62.2 ± 8.5
Sex (male)	3363 (55.2)
Education (years)	7.84 ± 10.7
Physician visit	4407 (72.4)
Financial status	
Excellent	68 (1.16)
Very good	107 (1.82)
Good	1599 (27.2)
Fair	3697 (62.8)
Poor	410 (7.0)
Marital status (Married)	4285 (70.4)
Healthy activities	
Vaccination	3384 (55.6)
Medical screening activities	3134 (51.5)
Exercise	2822 (46.4)
Smoking	5064 (83.2)
0	195 (3.2)
1	1054 (17.3)
2	1918 (31.5)
3	2166 (35.6)
4	754 (12.4)

Table 2.

Healthy activities in 2012 and frailty in 2015, bivariate analysis

	Nonfrail	**Frail**	
Healthy activities	n (%) o mean ± SD p-value	n (%) o mean ± SD	P value
Vaccination	2074 (54.8)	1310 (56.9)	0.121
Medical screening activities	1973 (52.1)	1161 (50.4)	0.182
Exercise	1849 (48.9)	973 (42.2)	< 0.0001
Smoking	3099 (81.9)	1965 (85.3)	0.001
Healthy activities			
0	127 (3.4)	68 (2.9)	0.469
1	635 (16.8)	419 (18.2)	
2	1184 (31.3)	734 (31.9)	
3	1356 (35.8)	810 (35.2)	
4	482 (21.7)	273 (11.8)	

Table 3.

Logistic regression 2015

	OR (95% CI)	**OR (95% CI)**
	Unadjusted	**Adjusted**
Healthy activities		
Vaccination	1.08 (0.97–1.20)	0.97 (0.87–1.09)
Medical screening activities	0.93 (0.84–1.03)	0.88 (0.77–1.0)
Exercise	0.76 (0.68–0.84)	0.79 (0.71–0.88)
Smoking	1.27 (1.11–1.47)	1.13 (0.97–1.31)
Healthy activities		
0	_	_
1	1.23 (0.89–1.69)	1.05 (0.75–1.46)
2	1.15 (0.85–1.57)	0.97 (0.70–1.33)
3	1.11 (0.82–1.51)	0.88 (0.63–1.21)
4	1.05 (0.76–1.47)	0.82 (0.58 – 1.16)