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Association of Healthy Habits Beliefs and Mortality in Older Adults: A Longitudinal Analysis of the Mexican Health and Aging Study

Julio M. Fernandez-Villa, Nutritionist (undergraduate),

Instituto Nacional de Geriatria, Mexico City

David X. Marquez, PhD,

University of Illinois at Chicago, Chicago, Illinois

Natalia Sanchez-Garrido, MD,

Instituto Nacional de Geriatria, Mexico City

Mario U. Perez-Zepeda, MD, PHD candidate, and

Instituto Nacional de Geriatria, Mexico City

Mariana Gonzalez-Lara, MC

Instituto Nacional de Geriatria, Mexico City, Instituto Nacional de Geriatria, Mexico City,

Universidad Nacional Autonoma de Mexico, Mexico City, Mexico

Abstract

Objective—The aim of this paper is to establish the association between beliefs about healthy habits and mortality in a group of Mexican older adults.

Methods—This is a longitudinal analysis of the Mexican Healthy Aging Study. During the eleven year follow-up overall mortality was registered. Survival curves were calculated and Cox regression models were fitted and adjusted.

Results—There was a significant difference ($p < 0.001$) in survival rate between those subjects who believed in healthy habits potential to improve health compared to those who did not. After adjustment for confounders, Cox regression models showed a hazard ratio of 0.016 (95% CI 0.009–0.026, $p < 0.001$) for the group that believed in healthy habits.

Discussion—Our results show a protective effect of believing that healthy habits could change one's own health. Though the mechanism is not completely clear, this should be taken into account in order to reframe beliefs of older adults that in turn could impact adverse outcomes.

Keywords

Aged; epidemiology of aging; health behavior; internal-external control

Correspondence concerning this article should be addressed to Julio Manuel Fernandez-Villa, Periferico Sur 2767, colonia San Jeronimo Lidice, Delegacion Magdalena Contreras, Zip code: 10200, Mexico City, Mexico.

Conflicts of interest statement

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Introduction

Over the last few decades the world's population has increased its number of older adults, mainly led by low fertility rates and an increase in life expectancy (INEGI, 2011; Omran, 1971). This phenomenon has been present for years in developed countries (i.e. Japan, Europe, Canada, United States of America), but more recently in developing countries such as Mexico, giving rise to the so-called accelerated population aging. According to data from the latest Mexican census in 2010 (INEGI, 2011), 9.06% of the national population is over 60 years old, and this frequency is expected to double by 2030 with an approximate growing rate of 3.8% per year (Gutierrez-Robledo, Palloni, Tellez-Royo Solis, & Wong, 2015). Population aging raises a number of questions related to health, and developing countries are in need of new data that could aid in confronting the requirements of this continuously growing age group (Prince et al., 2015), as an effort to understand these needs, large epidemiological studies of specific populations have been developed –such as the Mexican Health and Aging Study (MHAS).

The most commonly reported mortality causes in Mexican older adults are diabetes mellitus, ischemic heart disease, cancer, and stroke; all non-communicable chronic diseases (Cordova-Villalobos et al., 2008). Moreover, it has been thought that the convergence of chronic diseases and aging can accelerate progression to disability and other adverse outcomes in individuals. In addition, some reports point to an anticipation phenomenon in older adults living in developing countries, in which younger adults have conditions (i.e., geriatric syndromes) expected only in the older ones (Perez-Zepeda, Avila-Funes, Gutierrez-Robledo, & Garcia-Pena, 2016). The combination of age-related conditions and chronic diseases, as well as adverse socio-economic factors conspires against the good health of older adults (Cesari, Perez-Zepeda, & Marzetti, 2017).

The health belief model was designed to predict health-related behaviors, that in turn translate into actions aimed at improving health status (Champion & Skinner, 2008; Cockerham, 2005). The healthy habits potential can be seen as part of the “perceived benefits” construct of the health belief model, which is dynamic in older adults with changes across this stage of life (i.e., in older adults choices could have a more powerful influence, because of life experience and perceived length of the benefit) (Carstensen, 2006).

Moreover, the healthy habits beliefs construct depends on several factors (social, economical, school attendance, chronic diseases) and one of the most important is health literacy. In fact, the model proposed by Cockerham describes the *habitus* (i.e., the health habit belief that defines the disposition to act) as a step previous to life choices, and the instauration of activities, relying too in motivation to change (Cockerham, 2005). In older adults we can assess the healthy habits beliefs construct as a process of adaptation to a new biological and social process, in which needs and priorities change and the perceived ability to modify health depends on the previous and new information, as well as on the individual and environmental context (Koops van 't Jagt, Hoeks, Jansen, de Winter, & Reijneveld, 2016).

A similar concept is that of locus of control, which proposes that a generalized attitude, belief, or expectancy regarding the nature of a causal relationship between behavior and its outcomes might affect the choices to cope with different problems, including health (Grotz, Hapke, Lampert, & Baumeister, 2011). It has been studied as two poles of the same phenomenon: the internal, the belief in one's sense of control and power over events happening in life; and the external, the belief that stochastic factors such as luck, chance, or fate affect life events (Rotter, 1966). People with high external locus of control are less involved in their own health management, exercise less, have fewer dental check-ups, eat less fruits and vegetables and look for less health information (Wardle & Steptoe, 2003). From a life-course approach the link between locus of control and life decisions demonstrates that a psychosocial context has an effect on life's choices that potentially lead to the development of adverse outcomes in late-life (e.g., mortality, disability, institutionalization) (Fry & Debats, 2006).

One of the main determinants of locus of control and beliefs regarding healthy habits, and frequently overlooked in older adults, is time horizon –the subjective perceived remaining time of life. In particular, when facing few years of life ahead, the benefit of implementing good habits could be viewed as less important (Carstensen, 2006; English & Carstensen, 2014).

Healthy habits that are implemented and made part of everyday living could diminish the impact of chronic disease and aging, modifying morbidity, and therefore mortality (Eyre et al., 2004; Ford, Bergmann, Boeing, Li, & Capewell, 2012; Marquez et al., 2011; Volkert, 2013). If health patterns are seen as a combination of biological, social and psychological factors, then the beginning of a healthy lifestyle starts with beliefs and ends with better outcomes (Rizzuto & Fratiglioni, 2014). For example, if an older adult believes that physical activity has the potential to improve his or her mobility, then he or she could start an exercise program (psychological factor), which will also depend on the availability in the neighborhood and economic issues (social factor), and that the exercise program suits the older adult's particular health conditions (biological factors).

Previous work on the search of association between locus of control, healthy habits and mortality exists, mostly for American populations, with different approaches to the topic (Angel, Angel, & Hill, 2009; Dalgard & Lund Håheim, 1998). In particular, the work of Angel & Angel on locus of control and health beliefs in Mexican older adults have different associations. Moreover, in that study unhealthy habits were not associated with internal locus of control or healthy habits beliefs (Angel et al., 2009), pointing to the material factor (i.e., health-care access, financial status, insurance, etc.) as an important determinant of health of older adults. Nevertheless, there is still a need of information on how health beliefs can shape older adults' health and, in particular, the health of older adults from developing countries with specific social and cultural backgrounds. Therefore, the aim of this paper is to establish whether there is an association between beliefs about healthy habits and mortality in a group of Mexican older adults, independent of other factors including locus of control.

Method

Study Design

The Mexican Health and Aging Study (MHAS) is a national cohort representative of about 13 million Mexican older adults with currently four waves: baseline in 2001 and follow-ups in 2003, 2012, and 2015. The complete methodology is described in detail elsewhere (Wong, Michaels-Obregon, & Palloni, 2015), in brief, it consists of a representative sample of adults 50 years of age or older, interviewed face to face in their homes with a questionnaire of twelve sections, gathering information from different domains, including social, demographical, health-related and others. Baseline questionnaires were performed in 2001, and for purposes of this analysis, 2012 follow-up was used. The baseline final sample included was 6,368 (of the original sample, $n=15,186$) older adults, after excluding those <60 years old ($n=8,559$) and with missing data ($n=173$). In addition, other 86 subjects that died in the first six months of follow-up were excluded (see below). There were no significant differences between those with missing data and those included (data upon request).

Mortality

All-cause mortality was registered, and months from baseline date to registered day of death (reported by next-of-kin) were used as the time variable. Early deaths (first 6 months) were excluded because early deaths can be seen as failures to follow-up, thus having different survival prospects as those who continued to be followed.(Lee, & Wang, 2003).

Healthy Habits Beliefs

Our construct of healthy habits beliefs was used to identify if there was consciousness about the capacity of improving health through behavior changes. The single-item question: “Do you think that a person of your age can improve his/her health through regular exercise, balanced diet, or by stopping smoking?” was used with ‘yes’ or ‘no’ answers.

Confounding Variables

In order to adjust for confounders, other variables were included. Socio-demographic variables included were: age, sex, marital status (married or not), and years in school. Smoking status in three categories (never smoked, formerly and currently smokes) and a question of physical activity (single question: “on average during the last two years, have you exercised or done hard physical work three or more times a week?”) were included as current healthy habits of the individuals. A sum of comorbidities (hypertension, diabetes, cancer, respiratory illness, heart attack) was included in order to adjust for chronic diseases. Cognitive impairment was defined with the Cross-Cultural Cognitive Examination (Mejia-Arango & Gutierrez, 2011) that is composed of five subtests, if two or more of these tests had a score lower than the proposed for normal cognitive performance, the older adult was considered to have cognitive impairment. The total score of a 9-item validated questionnaire to assess late-life depressive symptoms, was included as a continuous variable (Aguilar-Navarro, Fuentes-Cantu, Avila-Funes, & Garcia-Mayo, 2007). From a total of ten activities of daily living plus instrumental activities of the daily living, the sum of those for which the

older adult had difficulty or did not perform was used to assess functionality. Finally, locus of control was also assessed with a questionnaire that contains eight items that classify locus of control into internal or external. Those items are on a Likert scale, and the highest score goes from 32 to the lowest score of eight, in which a higher value means higher internal locus of control.

Statistical Analysis

Descriptive statistics were performed for all the variables, with means and standard deviations for continuous variables and frequencies for categorical ones. A bivariate analysis was performed in order to test significance for all the variables by survival status, using t-test for continuous variables and chi square test for categorical ones. Curves for all-cause mortality were calculated using Kaplan-Meier curves to estimate the survival function, with time measured in months and with a follow-up of 132 months, lost subjects to follow-up were censored. The log-rank test was used to test statistical significance between the survival curves of those who believe in healthy habits as a way to improve health and those who do not. Correlation between locus of control and health beliefs were run with Spearman's rho. Cox regression models were fitted in order to estimate the hazard ratio in unadjusted and adjusted models (entering all the variables in the model). In addition to the above-described variables, one interaction term was included: between baseline age and healthy habits beliefs (first interaction term=age in years*yes/no response to the healthy habits question). In addition, time-varying variables were also taken into account into the model (age, health beliefs, locus of control). Proportional hazards assumption was tested by log-log graphs. All statistical analyses were done with STATA 14 ® (StataCorp 4905; Lakeway Drive; College Station, Texas 77845 USA).

Ethical Issues

The Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, the Instituto Nacional de Estadística y Geografía, the Instituto Nacional de Salud Pública and the Instituto Nacional de Geriatria in Mexico approved the study. All study subjects signed an informed consent form.

Results

General Description

For a total of 6,368 older adults at baseline, mean age was 69.07 years ($SD \pm 7.31$) and the majority of the population were women (53.49%). Up to 91% subjects ($n=5,798$) had the belief that exercise or a balanced diet or stopping smoking can change health status. As for healthy habits, 28.35% of the population reported having had done exercise or hard work (at least three times a week) and 54.4% ($n=3,465$) had never smoked. The mean number of comorbidities was 0.99 ($SD \pm 0.98$). The mean score locus of control questionnaire score was 24.24 ($SD \pm 3.7$). A full description of the population can be found in Table 1. In supplementary table 1, comparison of the variables by health beliefs is shown.

Survival Analysis

Mortality was associated with age, being male, being single, less years of schooling, not having exercised in the past two years, number of comorbidities, cognitive impairment, depression, difficulty of performing daily living activities and instrumental activities of the daily living (ADL/IADL) and lower score for locus of control (external locus of control). The beliefs that exercise, diet and smoking can change health status were also related to incidence of death, with the highest mortality incidence in those not believing that these habits could change health ($p=0.001$; Table 1). Spearman's rho for correlation between health beliefs and locus of control was of 0.131 ($p<0.001$).

The Cox regression model resulted in significant HR for the unadjusted model of those who believes in health beliefs, and mortality (0.79, 95% CI 0.68–0.92, $p=0.003$). For those who believed in healthy habits, adjusted for sex, marital status, years in school, physical activity, smoking status, comorbidities, cognitive impairment, depressive symptoms, difficulties in activities and instrumental activities of daily living, locus of control and interaction between age and believing in healthy habits had HR of 0.18 (95% CI 0.08–0.4, $p<0.001$), showing a lower risk of death than the unadjusted model (Table 2). Other variables significant HR were age, sex, years in school, physical activity, currently smoking, comorbidities, cognitive impairment and the interaction term.

In the supplementary material, both the Kaplan-Meier curves and the Cox regression model results are shown without dropping those subjects who died in the first six months, with similar results.

Discussion

According to our analysis of this national sample, belief in the potential of health-related activities to improve health has a protective effect on mortality; even after adjustment for other known factors that can affect mortality, the association persisted, and even strengthened, because of the inclusion of other strongly associated with morbidity variables, such as smoking status and age.

Mortality can be seen as the final outcome of life; it is a complex process that goes beyond physical factors. Our choices are important because they reflect our social and personal context and modify the way we deliberately cope with diseases and health risks.

The mechanism on how the healthy habits beliefs affect mortality is not completely understood. The socio-emotional selectivity theory proposes that as the subjective perception of remaining time of life (time horizon) seems shorter, there is a preference for emotionally positive information (happiness, positive memory) over negative information (risks, negative outcomes). As this horizon comes closer with age, the psychodynamic strategies to cope with life and disease changes (Carstensen, 2006); in our study this was reflected by the interaction of baseline age and health beliefs, the higher the age the lower the percentage of older adults with positive health beliefs. Hence, older adults with perceived short life horizons probably do not believe that health-related actions can improve his/her own life, and as a consequence this could be translated into poor outcomes, as a result of a condition

that objectively shortens the life horizon or the lack of adherence/interest in health-related habits. The lack of a relationship between locus of control and survival may be related to the importance of other variables such as age, sex, and morbidities. So regardless of the internal or external locus of control, the previous and underlying conditions may have more power over mortality. This is in line with other studies, where locus of control alone does not have an effect on survival (Dalgard & Lund Håheim, 1998).

The fact that aging modifies the health status along with chronic diseases, we should question ourselves about the approach to adopt self-care of health as deliberate and continuous process. We should encourage the beliefs about health behaviors potential to improve health, if we manage to do this we can help the motivational process to be translated into health behaviors (Bardach, Schoenberg, Howell, 2016). A recently published work on a model of interventions on health risks for older adults demonstrated that health behaviors could diminish the burden of disease and disability in a group of older adults (Stuck et al., 2015).

The implications of this leads to more of a primary care approach, where improvement is plausible and the preventive strategies related to healthy habits, if adopted early, can stop the development of age-related conditions (Stewart, Chipperfield, Perry, & Hamm, 2016).

It also seems that in older adults with an increased age the relationship between health beliefs and health behaviors is not diminished; however, older adults perceived confidence in the ability to make effective changes influenced their likelihood of engaging in healthy behaviors such as diet and physical activity (Bardach et al, 2016; Ferrini, 1994). Changes are also dependent on perceived barriers and other demographic characteristics. People who maximize the number of healthy lifestyle behaviors have a substantially reduced risk for developing chronic disease morbidity or mortality compared to those who have no healthy lifestyle behaviors (Ford et al, 2012).

Our results can help with the development of public health interventions. It has previously been stated that a theoretical framework can improve the effectiveness of such programs, since the subjective perception of health improvement by healthy habits studied here has an effect on mortality and survival. Interventions should take account of this decision making process that could eventually lead to intention and action (Glanz & Bishop, 2010).

Despite the novel findings of the current study, one of the main limitations of our work is the self-report bias of the information; however, adjusting for cognitive impairment is a proven strategy to diminish the bias (Schwarz, 2007). The measure of health beliefs as a single question can be seen as a limitation, nonetheless, this is the first paper using the Health belief model in Mexican older adults. In addition, it is difficult to trace the path from a belief to what actually happens with health, giving rise to concerns of residual confounding. Nevertheless, our results should encourage further research on this topic. New approaches to this problem could include assessment of trajectories of locus of control and health beliefs, and their relationships to health behaviors. In addition, comparison between different social and cultural contexts would also help to understand how a specific environment impacts health beliefs and behaviors. Also of importance would be the testing of mediation between

the elements proposed and the search for other mediators between the relation of health beliefs and survival. These and other approaches will help in closing the gap of the current knowledge on this phenomena.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Graph 1.
Kaplan-Meier Survival Curve Stratified for Health Beliefs

Table 1

General Characteristics by Survival Status

Characteristic	Total * (N=6,368)	Survived (n=4,615 [72.47%])	Not Survived (n=1,753 [27.53%])	p-value
Age, mean (SD)	69.07 (7.31)	67.75 (6.63)	72.53 (7.86)	<0.001
Women, n (%)	3,406 (53.49)	2,573 (75.5)	833 (24.4)	<0.001
Married, n (%)	3,914 (61.46)	2,906 (74.2)	1,008 (25.8)	<0.001
Years in school, mean (SD)	3.64 (4.01)	3.84 (4.1)	3.13 (3.74)	<0.001
Physical activity, n (%)	1,795 (28.35)	1,397 (77.8)	398 (22.2)	<0.001
Smoking status, n (%)				
Never smoked	3,465 (54.4)	2,599 (75)	866 (25)	<0.001
Formerly smoked	1,936 (30.4)	1,329 (68.6)	607 (31.4)	
Currently smokes	967 (15.1)	687 (71)	280 (29)	
Number of comorbidities, mean (SD)	0.99 (0.98)	0.92 (0.95)	1.16 (1.02)	<0.001
Cognitive impairment, n (%)	2,853 (44.8)	1,871 (65.6)	982 (34.4)	<0.001
Depressive symptoms score, mean (SD)	3.8 (2.6)	3.68 (2.65)	4.11 (2.65)	<0.001
Difficulties in activities of daily living $\bar{x}$, mean (SD)	0.65 (1.68)	0.52 (1.5)	0.98 (2.05)	<0.001
Locus of control score, mean (SD)	24.24 (3.7)	24.3 (3.79)	23.9 (3.71)	<0.001
Positive health beliefs $\int$, n (%)	5,798 (91)	4,234 (73)	1,564 (27)	0.002

* Percentages for 'Total' column correspond to column and the other columns for the row

$\bar{x}$ Number of difficulties that the older adult has to perform activities of daily living or instrumental activities of daily living

$\int$ Believes that regular exercise, balanced diet or stop smoking will change health status

Table 2

Unadjusted and adjusted Cox regression models for survival and believing in healthy habits.

	Unadjusted		Adjusted *	
	HR (95% CI)	p-value	HR (95% CI)	p-value
Health beliefs	0.79 (0.68–0.92)	0.003	0.17 (0.07–0.38)	<0.001
Age	-		1 (1.01–1.02)	<0.001
Women	-		1.37 (1.2–1.52)	<0.001
Married	-		0.92 (0.83–1.03)	0.168
Years in school	-		0.98 (0.97–0.9)	0.027
Physical activity	-		0.85 (0.76–0.96)	0.008
Smoking status	-		Reference	
Never smoked				
Formerly smoked				
Currently smokes			1.06 (0.95–1.19)	0.246
			1.23 (1.06–1.42)	0.004
Number of comorbidities	-		1.21 (1.16–1.27)	<0.001
Cognitive impairment	-		1.16 (1.04–1.29)	0.004
Depressive symptoms score	-		1.01 (0.9–1.02)	0.324
Difficulties in activities of daily living	-		0.9 (0.96–1.01)	0.594
Locus of control score	-		0.9 (0.97–1)	0.249
Interaction term (age* health beliefs)	-		1.02 (1.01–1.03)	<0.001

HR= hazard ratio

* Adjusted for sex, marital status, years in school, physical activity, smoking status, comorbidities, cognitive impairment, depressive symptoms, difficulties in activities of daily living or instrumental activities of daily living, locus of control, interaction between age and believing in healthy habits