Short-Term Effect of Physical Activity and Obesity on disability in a Sample of Rural Elderly in Mexico

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Abstract

Objective. To estimate the effects of physical activity (PA) and obesity on the cumulative incidence of the basic activities of daily living (ADLs) disability in the elderly. Methods. Longitudinal study. We selected 2,477 participants aged 65-74 years from the impact evaluation study of a non-contributory pension program in Mexico. Participants were without disability at baseline. Katz index was used to assess disability both at baseline and follow-up. PA, body mass index (BMI), and covariates were measured at baseline. **Results**. After 14-months of follow-up, the cumulative incidence of disability reached 10.1%. High PA was found to reduce disability risk (OR=0.64; 95%CI (0.43-0.95), and the association between obesity and disability was marginally significant (OR=1.36; 95%CI (0.96-1.95). **Conclusion.** Use the functional assessment of older adults in primary care to identify patients with functional dependence it is required, and promote physical activity to maintain muscle mass and thus reduce the incidence of disability.

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Background

The negative consequences of disability in the elderly are multifold. It undermines their health, self-esteem, perception of well-being, and quality of life (Dorantes-Mendoza et al., 2007, Guralnik et al., 2001); exacerbates the burden on hospital services, heightens the demand for health care (Mor et al., 1994); and constitutes an important mortality predictor (Guralnik et al., 1994).

Numerous health conditions can lead to disability: cognitive impairment, depression, specific co-morbidities, arthritis, visual, and hearing problems, falls, lower extremity function limitations and slow gait, in addition to current smoking and alcohol consumption (Marengoni et al., 2009, Menendez et al., 2005).

Obesity has also been mentioned in the literature as a correlate of disability, and has been associated with high risk for limited physical mobility (Brach et al., 2004, He and Baker, 2004, Lang et al., 2007, Woo et al., 2007), which in turn leads to the development and acceleration of disability among the elderly (Al Snih et al., 2007, Houston et al., 2005, Lang et al., 2008, Song et al., 2007).

Regarding physical activity (PA), several prospective studies have also identified that regular PA (He and Baker, 2004, Lang et al., 2007, Stessman et al., 2002) or intense PA (Balzi et al., 2010, Brach et al., 2004, Gerst et al., 2011) decreases the risk of disability or mobility problems. However, little has been studied about these relationships among rural populations in Mexico.

In Mexico, older adults (OA) represent the highest-growth segment and constitutes almost 10 million individuals aged 60 and older (8.9% of the total population), of whom 27% reside in rural communities (INEGI, 2010). Lack of access to health services poses a particularly critical issue for the rural elderly, most of whom have never worked in the formal sector of the economy and therefore reach old age without retirement pensions or health care (Gutierrez, 2010, Wallace and Gutierrez, 2005). This translates into inadequate health care, undiagnosed illnesses and, consequently, not opportune treatment (Wong, 2007).

Furthermore, it has been reported that the poorer the elderly, the more likely they are to develop functional limitations (Louie and Ward, 2011), thus confirming that the frequency of many chronic conditions affecting physical function escalates among populations suffer greater economic vulnerability. Mexico, for example, has reported a high prevalence of disability in rural elderly (30%), reflecting a heavy burden of this disease in this population (Manrique-Espinoza et al., 2011). The present study was conducted with the aim of estimating the effect of obesity and PA on the cumulative incidence of basic ADL disability within a sample of poor rural elderly in Mexico.

Methods

Design and Sample

The elderly in our analytic sample were part of the impact evaluation study of Program *70 y más* that was conducted in Mexico during 2007-2009. *70 y más* was a program of non-contributory social pension which initially benefited older people, ≥70 years, residing in localities with a population of up to 2,500 inhabitants in 2007 and was expanded to localities of up to 30,000 inhabitants in 2008. The evaluation was designed to estimate the effect of *70 y más* on the lives of its beneficiaries in terms of income, physical and mental health, and nutritional status. Details of the methodology of evaluation as well as the sampling procedures have been previously reported (INSP, 2009). Nevertheless; we summarize some of the overall characteristics of the previously stated study.

The evaluation study consisted in a prospective study of 6000 elderly aged 65 to 74 years in 2007, and residents of seven Mexican states. The response rate for the evaluation study in the basal measurement (2007) was 91%. Additionally, follow-up measurements were conducted in November 2008 and March 2009.

The present study used a subsample selected from the larger *70 y más* sample. From the full *70 y más* baseline sample of 5,465, with the purpose of obtaining the cumulative incidence of disability, we selected OA who did not present the event of interest at baseline, that is, those who had no difficulty executing any basic ADLs in 2007. In addition to the 681 (12.5%) elderly excluded and who showed at least one disability in basic ADLs, we also excluded who: presented incomplete information on basic ADLs (n=17), were unable to move (n=12) and lacked body mass index (BMI) or PA data (n=1,654). This procedure left a follow-up sample of 3,101 individuals, of whom 624 were excluded due to: death (n=9), impossibility of achieving the interview (n=150), as well as missing values in study covariates (n=465). Our analytical sample was thus composed of 2,477 subjects (Figure 1); which corresponds to 51% of original cohort.

The OA excluded from the analysis generally shared similar characteristics with the subjects in the analytical sample in the following variables: age, literacy, living arrangement, smoking status, and current alcohol consumption. However, OA excluded were significantly different in the following characteristics: more women (52% vs. 48.9%, p=0.033), higher visual problems (15.9% vs. 11.6%, p<0.001) and greater number of chronic diseases (0.78±0.96 vs.0.68±1.04, p=0.002).

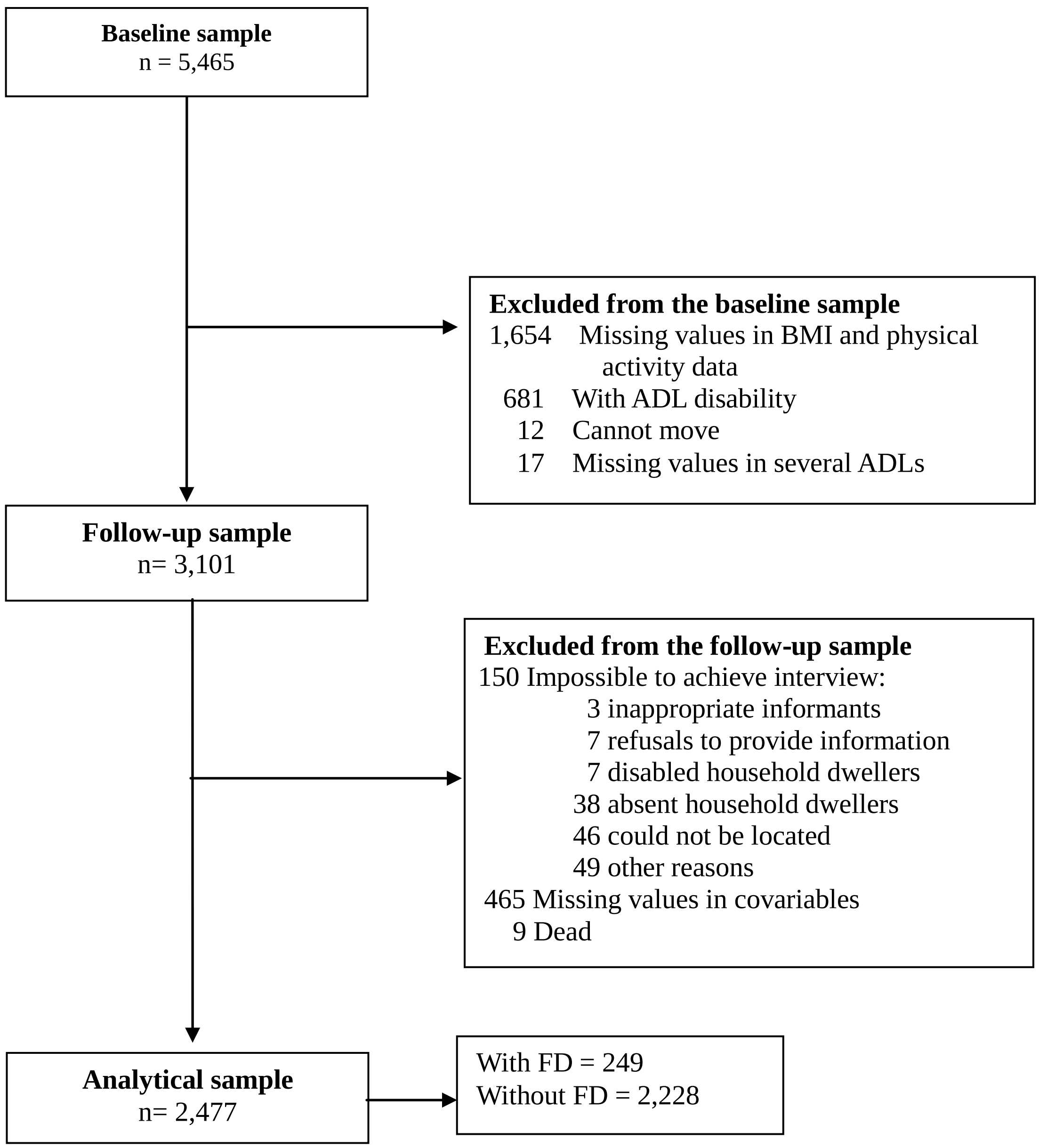

Figure 1. Selected study sample, Mexico 2007-2009

Data Collection

Elderly were interviewed at home by standardized personnel working for the National Institute of Public Health. Data collected featured the following socio-demographic characteristics: education, lifestyles, physical and mental health, nutrition and use of health services.

Measurement of Variables

Outcome. Disability was evaluated (based on self-report) in relation to the basic ADLs. The elderly were asked whether they needed help in performing any ADLs (ie., walking, bathing, eating, going to bed or using the bathroom) and, based on Katz's index (Katz et al., 1983), a dichotomous variable was defined, where 1 was attributed to reports of at least one difficulty in performing ADLs and 0 otherwise. Disability incidence was established at follow-up (after 14 months) and only among those subjects who presented no disability at baseline.

Exposure variables. Physical activity was assessed using the same short version of the International Physical Activity Questionnaire (IPAQ) administered in the Mexican National Health and Nutrition Survey 2006 (Gomez et al., 2009). The IPAQ collects data on the frequency (days/week) and duration (minutes/day) of three domains (vigorous activity, moderate activity and walking), and asks for activities of work, leisure-time, house and garden work, and transportation. Participants self-reported the number of days and the time spent in the last seven days. Since many elderly performed activities of the primary sector of the economy, questions were adjusted and examples were provided. Vigorous activity included: aerobics, bicycling at high speed, lifting heavy objects, digging and performing agricultural tasks, such as harvesting, etc. Moderate activity included: lifting light objects and moving them from one place to another, bicycling at normal speed, etc. Walking question included: walks for work, exercise, recreation or transport. According to these responses, total PA was calculated by adding the number of MET/minutes/week for each domain with the following mean values: 8.0 MET for vigorous activity, 4.0 MET for moderate activity and 3.3 MET for walking (IPAQ, 2005). Then, total PA was categorized into low (<600 MET/minutes/week), moderate (≥600 to <3000 MET/minutes/week), and high (≥3000 MET /minutes/week). Low PA was the reference group.

Standardized personnel measured weight and height at baseline according to a protocol (Habicht, 1974, Lohman et al., 1991). BMI was calculated as kg/m^2, and classified into: underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obesity (≥30.0 kg/m^2). Subjects with normal BMI were taken as the reference group (WHO, 2003).

Covariates. We included several socio-demographic and health-related characteristics measured at baseline, specifically: sex (1=female), age, literacy (1=could read and write, and 0 otherwise), and living arrangements (1=lived alone and 0 otherwise). Co-morbidities were measured asking participants if a physician had diagnosed them with hypertension, diabetes, dyslipidemia, myocardial infarction, angina pectoris, heart disease, stroke, chronic lung disease, osteoporosis, and cancer. We computed the number of co-morbidities, and the sum ranged from 0 to 8 diseases. Data on current smoking status (1=if at the time of interview, reported smoking at least 100 cigarettes, and 0=otherwise), current alcohol consumption (1=if at the time of interview, reported alcohol consumption, and 0=otherwise), visual problems (1=self-report of poor or severe impairment of distant or near vision even if they wear glasses and 0=otherwise), and cognitive impairment, which was operationalized by using five variables that assessed the following dimensions: spatio/temporal orientation, primary and secondary verbal memory, language, and motor activity (1= yes and 0=no).

Statistical Analysis

Descriptive statistics are presented as percentages for categorical variables. Age and co-morbidities are presented as mean±SD. Chi-square statistic or *t* test was used to determine the differences in the onset of disability by socio-demographic and health-related characteristics. A logistic regression model was used to estimate the effect of PA and BMI on the cumulative incidence of disability. We adjusted two consecutive models: the first reports the effect of PA and BMI without the covariates adjustment; while the second includes the covariates. Both models were evaluated in terms of residual analysis, influence measures and collinearity. Differences were considered statistically significant if $p<0.05$, and considered marginally significant if $0.05<p<0.10$. All analyses were performed using STATA 11.0.

Ethical Review

The Research and Ethics Committees of Mexico's National Institute of Public Health approved the original study. Participants received a detailed explanation of the procedures and signed an informed consent declaration before data collection occurred.

Results

Table I shows the baseline characteristics of the elderly in our sample. Mean age was 69.4±2.9 years, nearly 50% were female, 34.6% were literate, 7.4% lived alone, 61.8% performed high levels of PA and 13.7% were obese.

At the14-month follow-up, the cumulative incidence of disability in basic ADLs was 10.1%. Table I compares the baseline characteristics according to ADL disability status at the follow-up. Differences were not statistically significant in terms of current smoking, current alcohol consumption, cognitive impairment and BMI; but significant in terms of high PA (p=0.022), visual problems (p=0.085), and co-morbidities (p<0.001).

Table I. Baseline characteristics by incident ADL disability, Mexico 2007-2009

	All n=2,477	ADL disability n=249	Non ADL Disability n=2,228	p-value[b]
Exposure variables				
Physical activity (%)				
Low	12.0	16.5	11.5	0.023
Moderate	26.2	28.9	25.9	0.304
High	61.8	54.6	62.5	0.014
Body mass index (%)				
Underweight	5.6	5.6	5.6	0.994
Normal range	46.5	42.6	47.0	0.189
Overweight	34.2	33.7	34.2	0.872
Obesity	13.7	18.1	13.2	0.034
Covariates				
Age (years)	69.4 ± 2.9	69.5 ± 2.9	69.4 ± 2.9	0.463
Female (%)	48.9	50.6	48.7	0.578
Literacy (%)	34.6	34.5	34.6	0.983
Elderly living alone (%)	7.4	7.2	7.4	0.919
Current smoking (%)	6.6	6.0	6.7	0.690
Current alcohol consumption (%)	10.3	9.6	10.4	0.719
Cognitive impairment (%)	5.9	4.0	6.1	0.185
Visual problems (%)	11.6	14.9	11.2	0.085
Co-morbidities [a]	0.68 ± 0.96	0.91 ± 1.0	0.66 ± 0.95	<0.001

[a] Hypertension, diabetes, dyslipidemia, myocardial infarction, angina pectoris, heart failure, other heart conditions, stroke, chronic lung disease, osteoporosis, cancer.
[b] Chi-square test or *t*-test comparing the incident ADL and Non-ADL disability groups.

Table II presents the results of the logistic regression model for the cumulative incidence of disability, for both models, with and without covariates adjustment. Being engaged in high PA reduced disability risk significantly, for both the unadjusted (OR=0.61; CI 95% 0.42-0.89) and the adjusted model (OR=0.64; CI 95% 0.43-0.95). There was no significant association between moderate level of PA and incidence of disability; however, it is possible to observe a trend of decreases in the risk of disability when PA increases. Regarding BMI, the model without covariates indicated that obese elderly were particularly prone to developing disability (OR=1.51; CI 95% 1.07-2.13). Likewise, the model adjusted for baseline characteristics showed a lower but still marginally significant relationship between obesity and disability (OR=1.36, $p<0.10$; CI 95% 0.96-1.95). Being under- or overweight did not associate with the incidence of ADL disability in the study sample.

Table II. Effect of physical activity and obesity on cumulative incidence of ADL disability, Mexico 2007-2009

	Model 1 Without covariates		**Model 2 With covariates[a]**	
	OR	**CI 95%**	**OR**	**CI 95%**
Physical activity				
Low	1.00	Reference	1.00	Reference
Moderate	0.78	(0.52-1.18)	0.80	(0.52-1.22)
High	0.61**	(0.42-0.89)	0.64**	(0.43-0.95)
Body mass index				
Underweight	1.11	(0.62-1.97)	1.09	(0.60-1.98)
Normal range	1.00	Reference	1.00	Reference
Overweight	1.09	(0.81-1.46)	1.01	(0.74-1.36)
Obesity	1.51**	(1.07-2.13)	1.36*	(0.96-1.95)

OR = odds ratio; CI = confidence interval
[a] Adjusted for covariates: age, sex, literacy, living arrangements, current smoking, current

alcohol consumption, cognitive impairment, visual problems, and number of co-morbidities.
**p-value < 0.05; *p-value < 0.10

Discussion

The results of our study found that, at the 14-month follow-up, high PA is a protective factor against disability, and that obesity is associated with increased risk of disability. Over the years, human beings become less physically active (Charansonney, 2011), but the elderly in our study sample remained highly active; six in ten subjects reported participating in activities that, as a whole, generated a considerable requirement (high PA). Some prospective studies have showed that high levels of PA in the elderly have a protective impact (Song et al., 2006, Balzi et al., 2010, Gerst et al., 2011, Stessman et al., 2002). Among OA in our study, dwelling in rural areas constituted a potential factor that determined greater levels of PA and, thus, a more active lifestyle.

While 60-65 years is considered retirement age in Mexico, in rural environments, where social security is uncommon (only 14% of rural elderly are covered by social security), reaching that age is not equivalent to retiring from economic activity (INSP, 2006). Regardless of their health status, the elderly are compelled to continue performing occupational activities (Salgado de Snyder et al., 2005).

The idea that a high level of PA is associated with lower risk of disability is based on the fact that more demanding activities play a key role increasing insulin sensitivity, reducing risk of cardiovascular diseases and increasing life expectancy, and these mechanisms might have positive effects on posture balance, inflammation biomarkers, and maintaining muscular strength (Avila-Funes and Garcia-Mayo, 2004). Some studies have suggested that resistance training programs improve physical condition and independence (Venturelli et al., 2010).

Some studies have found that obesity is associated with disability (Lang et al., 2008, Al Snih et al., 2007, Houston et al., 2005) but we only found a marginal association. However, this is consistent with findings on the association between obesity and risk of disability in Hispanic populations (Al Snih et al., 2010, Al Snih et al., 2009). In this context, our study can contribute to a better understanding of the association between body weight and disability, particularly among rural populations. It is possible that the marginal effect of BMI on disability can be explained by the particular profile of our study group. The elderly in our study belong to a select group that has survived conditions of shortage, deprivation, infections and diseases throughout their lives and the effect of BMI could have been more evident. Another explanation may reside in the use of BMI, which in itself is not an optimum indicator among elderly people. While BMI captures total body fat, it is seriously limited in its ability to distinguish body-fat distribution or between fat mass and lean mass (Snijder et al., 2006). This is relevant, as loss of lean mass is a part of ageing and therefore linked to loss of independence (Fielding et al., 2011). Even so, evidence has shown that is necessary a complete and exhaustive revision about the use of BMI, and the appropriateness of its cutoffs to the older adult population (Berraho et al., 2010).

Our study revealed that 10.1% elderly had developed disability. This number is similar to those reported for Mexican and Hispanic populations, where disability incidence ranged between 6.5% and 10.9% in a two year period (Brach et al., 2004, Fielding et al., 2011, Wong, 2007). Given that our follow-up term was barely over a year and our sample of elderly participants pertained to the younger segment of the OA (65-74 years), the incidence under our research can be considered high. Results suggest that unobserved variables, such as the environment, may influence disability. With mobility identified as the basic activity most affected in this population (Song et al., 2007), it can be argued that settings with substantial obstructions (i.e., badly paved streets, insufficient sidewalks, hillside dwellings, uneven terrain, limited infrastructure and deficient public services) (Louie and Ward, 2011) may be responsible for falls and then cause disability. This is an issue of great concern, because it has been reported that functionally disabled individuals residing in marginalized social contexts have fewer labor opportunities, lower incomes and less tools to face adversity. Additionally, they commonly lack access to medical and rehabilitation services (Guralnik et al., 1994, Katz et al., 1983, Stessman et al., 2002).

The main limitation of this study is the duration of our follow-up which did not allow for identifying which OA were in the process of functional impairment. A longer follow-up period would have probably revealed a higher disability incidence. Another limitation was the self-reported functional status and PA assessment, which could be subject to recall bias. In general, people tend to over-report PA (Shephard, 2003). However we use standardized instruments to obtain reliable information on functional status and PA, and professional and fully standardize interviewers followed a detailed protocol. An additional limitation of our study is the definition of the analytical sample; elderly excluded from the analytical sample, were mostly women, with vision problems, and had a greater number of co-morbidities. In all likelihood, this means that the elderly excluded from the analysis, may have been in a position of greater disability and that it may be susceptible to selection bias.

Finally, the evidence presented here should prompt health personnel to refine routine check-ups with an assessment of ADL performance in the elderly as a means of detecting the risk of disability. In fact, this functional assessment could be performed in the primary care health services. On the other hand, assuming PA is important to minimize the impact of disability, it should be included as part of a strategy in maintaining muscle mass (Venturelli et al., 2010). Specially, exercise programs like the multicomponent strength training, appear to be the most effective interventions to delay disability (Izquierdo et al., 2013).

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