The Health Effects of Spousal Caregiving on Middle-Aged and Older Mexican Adults: A Targeted Estimation Approach

Jacqueline M. Torres, Kara E. Rudolph, Uchechi A. Mitchell, Mienah Z. Sharif, Rebeca Wong, M. Maria Glymour

Despite rapid population aging, older adults in many low and middle-income countries (LMICs) face inadequate or non-existent formal long-term services and supports, leaving family members to provide old-age care.[1] Research from high-income countries generally points to adverse associations between family caregiving and the health of caregivers.[2-4] Less research has examined the impact of later-life caregiving on health in LMICs. There may be substantial differences within LMICs that serve to protect family caregivers from the adverse health outcomes often documented for caregivers in high-income countries (e.g. higher prevalence of co-residence with extended family members). On the other hand, many LMICs are experiencing declining family size, out-migration of working age children, and a growing prevalence of women in the workplace. These changes may place increased pressure on fewer family members to provide care, with potentially adverse consequences for the health of these family caregivers.

Beyond the need for more attention to the health effects of caregiving in LMIC contexts, there is also a greater need for more methodological rigor in the modeling of relationships between caregiving and health. The ability to take on caregiving roles may depend critically on aspects of a potential caregiver's own health, economic, and social circumstances, all of which might also influence a wide range of mental and physical health outcomes (Fig. 1). Moreover, caregiving may be a function of the care recipient's health, economic, and social circumstances, which may also independently influence the wellbeing of their family members beyond their actual impact on caregiving. Estimated associations between family caregiving and health may therefore be substantially confounded by characteristics of caregivers and care recipients, as well as relationships between the two. The few analyses that attempt to address confounding in caregiver health often rely on the correct specification of a single model (e.g. the propensity score model). The extant research also includes few longitudinal studies that model caregiving as a time-varying exposure. Caregiving status may be dynamic over time as caregivers and care recipients recover, experience changes in health status, age, and die, but there is a dearth of literature evaluating the associations between dynamic caregiving patterns and time-varying health outcomes.[2]

We aim to make a contribution to research on the health effects of caregiving in LMICs, evaluating the effect of spousal caregiving on caregiver depressive symptoms and functional limitations using population-based data on middle-aged and older Mexican adults followed over a 14-year period. We use a doubly robust estimation strategy that reduces reliance on the correct estimation of a single model. In preliminary analyses, we employ this estimation strategy to evaluate the association between spousal caregiving and mental and physical health in cross-section. We will extend this work to evaluate the longitudinal, dynamic relationship between family caregiving, caregiver health, and attrition over the full 14-year period (following the Directed Acyclic Graph in Fig. 2).

Data and Methods

Data come from four waves of the Mexican Health and Aging Study (MHAS).[5] At baseline (2001), the MHAS was a nationally representative sample of Mexican adults aged $\geq$ 50 years.

The MHAS selected households with adults ≥ 50 years; Mexican states with historically high rates of out-migration to the US were oversampled. Within each household, a target respondent and the spouse or cohabitating partner (regardless of age) were interviewed. Proxy respondents for older adults who could not respond on their own were also interviewed. Response rates were 91.8% in 2001, 93.3% in 2003, 88.1% in 2012, and 88.3% in 2015. The MHAS surveyed 15186 respondents at baseline. Spouses < 50 years old at baseline (2001) and respondents who were never married, widowed, separated, or divorced at baseline were excluded from the primary analyses. Respondents whose interviews were completed by proxies were excluded from the baseline analytic sample, although information from proxy interviews was used to develop the measure of spousal needs for assistance with activities of daily living. The baseline analytic sample included 3903 women and 4761 men who were married or in a union.

Exposures

Respondents were not asked directly about care for spouses. Instead, each respondent was asked about their own needs for assistance with basic activities of daily living (ADLs) (i.e. getting out of bed, getting dressed, walking, bathing, toileting, eating) and instrumental ADLs (IADLs) (i.e. shopping for food, managing money, preparing meals, taking medications). When a respondent indicated a need for assistance with a given ADL, they were subsequently asked whether or not their spouse or another person provided them with assistance with that activity. However, nearly all married respondents who reported having a need for assistance with ADLs also reported that their spouse helped them with at least one ADL. We therefore utilized two binary exposure measures of whether or not a respondent's spouse reported need for assistance with 1) at least one ADL or IADL or 2) with an ADL only.

Outcomes

Depressive symptoms were measured with a modified 9-item Center for Epidemiological Studies – Depression (CES-D) scale.[6] The scale was adapted in the style of the 8-item CES-D scale used for the Health and Retirement Study, which reduced responses to 'yes' or 'no' for ease of use with low-education older adults.[7] Lower-body functional limitations (LBFLs) were measured with eight questions regarding perceived difficulty with: running one mile, walking one or several blocks, climbing one or several flights of stairs, stooping, kneeling, or crouching. For each item, we contrasted those who had "no trouble" with the activity to those who reported they "have trouble, can't do, or don't do" the activity. Activities that respondents had difficulty with were summed to create a continuous measure of LBFLs. Expanded analyses will also evaluate binary measures of elevated depressive symptoms and at least one (versus no) LBFL.

Covariates

Covariates included in preliminary analyses are measures that might have plausibly influenced and preceded baseline exposure and outcome measures. These measures correspond to respondents' early and mid-life characteristics: age in years, parental educational attainment, own educational attainment, childhood material conditions, childhood health, whether respondents held a domestic or agricultural lifetime occupation versus another lifetime occupation, whether respondents had been married more than once (versus only once), urban residence, residence in a historically high out-migration state, total number of living children, and total number of living grandchildren. Additional covariates included spouses' age in years, spouses' years of educational attainment, and spouses' lifetime occupation. All models are

stratified by gender. Longitudinal analyses will additionally include lagged time-varying confounders, including respondent and spouses' time-varying health, economic, and family composition measures.

Statistical Analyses

We used Targeted Maximum Likelihood Estimation (TMLE)[8-10] to estimate associations between spousal caregiving and each health outcome. TMLE is a doubly robust estimation approach that allows for data-adaptive model fitting and, in a longitudinal setting, incorporates time-varying exposures and appropriately accounts for time-varying confounders affected by prior exposure. Briefly, the TMLE estimation approach entails fitting outcome models and predicting counterfactual values, plugging in exposure contrasts that corresponded to the effect of interest – in our case, having a spouse that needed assistance with ≥ 1 ADL versus having a spouse that needed no such assistance. These initial predictions are then updated with inverse probability of treatment weights; these IPTWs were generated from models of spousal need for assistance with ADLs conditional on covariates described above. Models were estimated data-adaptively via the SuperLearner[11]; the weighted convex combination of machine-learning algorithms with the lowest cross-validated mean squared error was selected among a library of thirteen possible machine learning algorithms. Missing data were addressed via multiple imputation;[12] 10 imputed datasets were generated and estimates were combined across these datasets using Rubin's rules.[13]

Preliminary Results

Married women and men in the baseline wave of the MHAS were about 60 years of age in 2001. Over a quarter (27.1%) of female respondents had a spouse that reported at least one need for assistance with a basic or instrumental activity of daily living (ADL); this was true for about 17% of male respondents. A substantially smaller proportion of respondents (12.7% of women and 11.3% of men) had spouses that needed assistance with at least one basic ADL.

For both women and men, having a spouse who needed assistance with at least one basic activity of daily living (ADL) or instrumental activity of daily living (IADL) was associated with more past-week depressive symptoms (women, Marginal Risk Difference (RD): 0.20, 95% CI: -0.01, 0.42; men, RD: 0.34, 95% CI: 0.08, 0.59) and more lower-body functional limitations (women, RD: 0.29, 95% CI: 0.12, 0.47; men, RD: 0.30, 95% CI: 0.10, 0.56) compared to not having a spouse who did not need assistance with ADL or IADLs (Table 1).

Having a spouse who needed assistance with an ADL was also associated with more depressive symptoms (women, RD: 0.59, 95% CI: 0.32, 0.87; RD for men: 0.34, 95% CI: 0.08, 0.60) and more lower-body functional limitations (women, RD: 0.43, 95% CI: 0.19, 0.67; men, RD: 0.28, 95% CI: 0.05, 0.51) as compared to having a spouse without a need for assistance with a basic ADL, although the magnitude of the associations were larger as compared to those estimated for having a spouse with any basic or instrumental need for assistance.

The full paper will evaluate associations between caregiving experience at baseline and follow-up waves with relevant outcomes measured at two, 11, and 14-years of follow-up. These longitudinal models will incorporate (lagged) time-varying covariates and respondent attrition due to respondent's own death or loss to follow-up, spouse's death, or the dissolution of marriage by the follow-up waves.

References

1. Mayston R, Lloyd-Sherlock P, Gallardo S, et al. A journey without maps-Understanding the costs of caring for dependent older people in Nigeria, China, Mexico and Peru. *PLoS One* 2017; 12: e0182360.

2. Pinquart M, Sörensen S. Correlates of physical health of informal caregivers: a meta-analysis. *J Gerontol B Psychol Sci Soc Sci* 2007; 62: P126-37.
3. Capistrant BD, Berkman LF, Glymour MM. Does duration of spousal caregiving affect risk of depression onset? Evidence from the Health and Retirement Study. *Am J Geriatr Psychiatry* 2014; 22: 766-70.
4. Roth DL, Haley WE, Hovater M, Perkins M, Wadley VG, Judd S. Family caregiving and all-cause mortality: findings from a population-based propensity-matched analysis. *Am J Epidemiol* 2013; 178: 1571-8.
5. Wong R, Michaels-Obregon A, Palloni A. Cohort Profile: The Mexican Health and Aging Study (MHAS). *International Journal of Epidemiology* 2015; ePub ahead of print.
6. Radloff LC. The CES-D scale, a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977; 1: 385-401.
7. Steffick DE. *Documentation of affective functioning measures in the Health and Retirement Study*. Ann Arbor, MI: Survey Research Center, University of Michigan; 2000.
8. Schuler MS, Rose S. Targeted Maximum Likelihood Estimation for Causal Inference in Observational Studies. *Am J Epidemiol* 2017; 185: 65-73.
9. Gruber S, van der Laan MJ. Targeted Maximum Likelihood Estimation: A Gentle Introduction. *UC Berkeley Division of Biostatistics Working Paper Series* 2009; Working Paper 252.
10. Lendle SD, Schwab J, Petersen ML, van der Laan MJ. ltmle: An R Package Implementing Targeted Minimum Loss-Based Estimation for Longitudinal Data, R package version 1.1-0. 2018.
11. Polley E, LeDell E, Kennedy C, Lendle S, van der Laan M. *SuperLearner: Super Learner Prediction.* R package version 2.0-22. 2017.
12. Honaker J, King G, Blackwell M. *Amelia II: A Program for Missing Data. R* package version 1.7.4. 2015.
13. Rubin DB. *Multiple Imputation for Nonresponse in Surveys*. New York, NY: Wiley; 1987.

Table 2. Preliminary findings for the relationship between spousal need for assistance with activities of daily living and the health of middle-aged and older caregivers in Mexico, 2001

	Women (n = 3903)		Men	(n = 4761)
	Marginal		Marginal	
Spouse needs assistance with > 1 basic ADL	RD	95% CI	RD	95% CI
Outcome: Past-week depressive symptoms (range: 0 - 9)	0.59	(0.32, 0.87)	0.34	(0.08, 0.60)
Outcome: Lower-body functional limitations	0.43	(0.19, 0.67)	0.28	(0.05, 0.51)
Spouse needs assistance with > 1 basic or instrumental ADL				
Outcome: Past-week depressive symptoms (range: 0 - 9)	0.20	(-0.01, 0.42)	0.34	(0.08, 0.59)
Outcome: Lower-body functional limitations	0.29	(0.12, 0.47)	0.30	(0.10, 0.56)

Source: Mexican Health and Aging Study, 2001. The following covariates were included in both treatment and outcome models: respondent age, early-life socio-economic status including years of educational attainment, lifetime occupation, and a measure of whether the respondent had been married once or more than once; spouse's age, educational attainment, and lifetime occupation; total number of living children, total number of grandchildren, residence in an urban area of Mexico, and residence in a historically high US out-migration state.

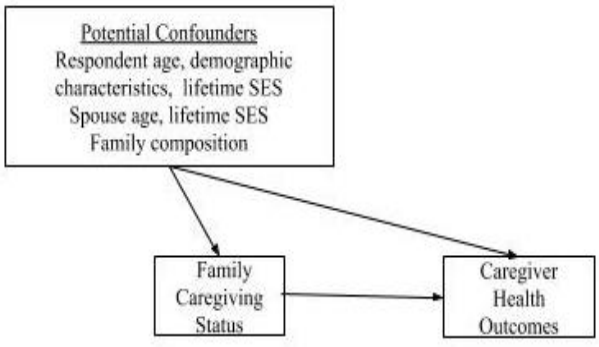

Figure 1. Directed Acyclic Graph Guiding Preliminary, Cross-Sectional Analyses

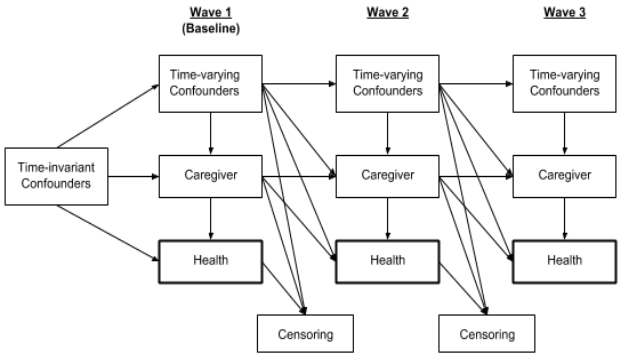

Figure 2. Directed Acyclic Graph Guiding Longitudinal Analyses of the Association between Time-Varying Family Caregiving Status and Time-Varying Health Outcomes