Rural and urban differences in lifetime occupation and its influence on mortality among Mexican adults

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Abstract

Objective. To determine how primary lifetime occupation type is associated with mortality, and how the relationship varies by rural and urban dwelling. **Materials and methods.** Data come from 2001-2018 Mexican Health and Aging Study (adults aged 50+, n=11 094). We created five occupation categories. Cox proportional hazard models predicted mortality using baseline covariates. **Results.** In both rural and urban settings, participants with manual jobs, such as agriculture and production/industrial jobs, had an increased risk of mortality compared to those with administrative/professional jobs. In urban settings, participants in the domestic/service and no main job categories had higher risk of mortality than those in the administrative/professional category. For men these differences remained, but not for women. **Conclusion.** In a context of rural and urban demographic shifts, it is crucial to consider the implications that occupation as a socioeconomic factor can have on health and to identify the most vulnerable groups.

Keywords: mortality; rural areas; urban areas; occupation; employment; socioeconomic factors; Mexico

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Resumen

Objetivo. Determinar cómo el tipo de ocupación principal a lo largo de la vida se asocia con la mortalidad y cómo varía la relación según la vivienda rural y urbana. **Material y métodos.** Los datos provienen del Estudio Nacional de Salud y Envejecimiento en México 2001-2018 en adultos de 50 años o más (n=11 094). Se crearon cinco categorías de ocupación. Para predecir el riesgo de mortalidad de acuerdo con la ocupación se usaron modelos proporcionales de Cox utilizando covariables de la encuesta basal. **Resultados.** Tanto en entornos rurales como urbanos, los participantes con trabajos manuales, como agricultura y trabajos de producción/industriales, tenían un mayor riesgo de mortalidad en comparación con aquéllos con trabajos administrativos/profesionales. En comunidades urbanas, los participantes en las categorías de trabajo doméstico/servicio y sin trabajo principal tenían mayor riesgo de mortalidad que los de la categoría administrativo/profesional. Entre los hombres se mantuvieron estas diferencias, pero no entre las mujeres. **Conclusiones.** En un contexto de cambios demográficos rurales y urbanos, es crucial considerar las implicaciones que la ocupación como factor socioeconómico puede tener en la salud e identificar los grupos más vulnerables.

Palabras clave: mortalidad; áreas rurales; áreas urbanas; ocupación laboral; empleo; factores socioeconómicos; México

Accumulated socioeconomic disadvantage characterizes the life course experience for many aging individuals in Mexico,[1,2] which can result in poorer health outcomes and shorter life expectancy. Studies have shown that lower early-life socioeconomic status, including education, is associated with increased

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mortality risk among Mexican adults.[3] Educational attainment plays an important role in determining the type of job an individual acquires in adult life, but the impact of occupation as a life course factor that influences mortality in Mexico has seldom been examined. Yet lifetime occupation can have a lasting impact on health as people age.

The relationship between occupation and mortality is well established in high-income countries.[4,5] More manual jobs have been associated with higher mortality in high-income countries. There is reason to believe that this association is stronger in low- and middle-income countries due to the underdeveloped field of occupational health and safety in these countries.[6] Even though deaths due to job have decreased in Mexico, the incidence of disease due to work is high.[7] This suggests that preventive measures and safety regulations have helped prevent death-by-work accidents. However, if the incidence of disease due to work is increasing, we must understand how these illnesses or injuries could lead to premature death in old age. We must also understand the dynamic between occupation and mortality, given that deaths in the workplace are underreported.[8] Moreover, the process of industrialization has shifted the occupational profile from agricultural jobs to more middle-skill manual jobs in manufacturing and the service industry,[9] which can also impact health outcomes in old age, including mortality.

Health disparities by rurality factor greatly in the relationship between occupation and mortality in Mexico. Studies have found that rural residents are at a greater disadvantage in certain outcomes, such as cognitive function, than urban residents.[10-12] The gap in educational attainment between both settings has been used to explain rural/urban differences in health outcomes, as living in rural areas is associated with having less access to education.[13] Educational attainment leads to occupational opportunities, and lower levels of educational attainment can lead to occupational experiences that are less favorable to health outcomes. Furthermore, Mexico has experienced rural-to-urban internal migration, driven by the availability of more occupational opportunities in urban areas.[14,15] Migrants to urban areas might have started working in agriculture but then shift to a higher skill level job in the city.[14] However, those who stay in rural areas continue to be disadvantaged due to lack of access to quality health care.[16] Thus, it is important to consider occupation and mortality in the context of rural and urban differences. Life course factors, such as rural and urban dwelling, may result in different occupational experiences and thus health disparities in Mexico.

Given the clear rural and urban health differentials, the occupational opportunities differing by rurality, and the importance of occupation to mortality, the aim of this study was to determine how primary lifetime occupation type is associated with mortality, and how the relationship varies by rural and urban dwelling. Studying this association in a middle-income country in the context of rural-urban migration and industrialization can inform the field of occupation and health, which is relatively understudied.

Materials and methods

Data

We used data from the Mexican Health and Aging Study (MHAS), a longitudinal and nationally representative household-based sample of adults aged 50 and older, and their spouses, in Mexico. The study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, and the *Instituto Nacional de Estadística y Geografía* (INEGI) and the *Instituto Nacional de Salud Pública* (INSP) in Mexico. MHAS contains representation from rural and urban areas. The first MHAS interviews were conducted in 2001 with a baseline sample of 15 402 participants. Follow-up interviews were completed in 2003, 2012, 2015, and 2018. MHAS has a low attrition rate. Even with a nine-year gap between the second and third wave, response rates were 93.3% in wave 2 (2003) and 88% in wave 3 (2012).[17] For this analysis, we followed participants from wave 1 (2001) to death or until wave 5 (2018), which provided a 17-year follow-up period.

Measures

Mortality was the outcome variable in this analysis. Next-of-kin interviews reported month and year of participant death, which was used to calculate time-to-event for mortality (time elapsed, in months, between the baseline interview and death). Censoring occurred for participants who were lost to follow-up or still alive at the end of the follow-up period (2018). Time-to-censor was calculated as time elapsed, in months, from baseline interview and last successful interview. For our sample, we excluded participants who, at baseline, were less than 50 years of age (n=1 943), had a proxy to complete an interview (n=417), had no follow-up data (n=994), had missing mortality or interview date data (n=115), had insufficient job information (50), and had missing covariate information (n=780). We also excluded men who reported having never worked (n=9) because of their small sample size compared to women. After exclusions, the total sample consisted of 11 094 participants observed at baseline, with 4 147 deaths over the 17-year follow-up.

We examined lifetime occupation by using participant responses to the question, "What is the name of the office, profession, or place where you worked in your main job?" Responses were assigned a 3-digit code by the INEGI; these codes are grouped into nineteen categories. We further condensed these occupational categories to five: (1) agriculture; (2) domestic workers and workers in service industry (domestic/service); (3) administrative, professionals, sales (administrative/professional); (4) production, repair, maintenance, industrial work, transportation (production/industrial); and (5) no main job. These categories were built to reflect similar job roles, activities, and education attainment as determined by highest level of education achieved, and to ensure that each category had adequate cell sizes for the analysis. A large majority (87.9%) of participants whose main lifetime occupation was in agriculture were agricultural laborers and for this reason we did not distinguish between manual and non-manual occupations within agriculture. Other investigators have used a similar process to categorize occupations based on common characteristics, using the MHAS data.[6,18] For consistency, we chose administrative/professional as the reference occupation category because the distribution of women and men in this category was the most even in comparison to agriculture or no main job, where the majority were men and women, respectively.

Our analysis was stratified by rurality. In the MHAS, the cut points for locality size are based on INEGI standards and are the most detailed measure of rurality available for public use available on this data set. For this analysis, we used categories of rurality previously used to study rural/urban differences using the MHAS data.[11,16] The rural category is defined as locality size of < 100 000 people, and the urban category is defined as a locality size of ≥100 000 people. In the 2001 baseline wave of the MHAS, 4 770 (43%) and 6 324 (57%) participants resided in rural and urban areas, respectively.

Covariates

All data on covariates came from the 2001 wave. We included covariates that are common mortality risk factors and associated with employment and health.[19-22] We controlled for sociodemographic characteristics, such as age (in years), sex (male or female), marital status (divorced/separated, married, single, widowed), and education (in years). We also controlled for health conditions, such as smoking status (current, former, never), a count of health conditions (range 0-7, including hypertension, diabetes, asthma, heart attack, stroke, arthritis, falls), depressive symptomatology (high, or low). In MHAS, depressive symptoms are measured using nine items from the Center for Epidemiological Studies Scale (CES-D). Participants were instructed to reply *yes* or *no* when asked how they felt in the past week (depressed, that everything they did was an effort, happy, lonely, sad, tired,) and what they experienced in the past week (had restless sleep, enjoyed life, had a lot of energy). We reverse coded items for happiness, enjoyed life, and energy. Participants with five or more depressive symptoms were categorized as having high depressive symptomatology.[23] We excluded participants who had four or more of the nine items missing (n= 120). We also controlled for the presence of a physical limitation. This measure was obtained from self-reports on the ability to conduct the basic activities of daily living (ADL) without help such as bathing, toileting, transferring into and out of bed, walking, dressing, and eating.[6] We further collapsed the number of disabilities into two categories to facilitate analysis: 0 or 1 or more physical limitations.

Statistical analysis

We compared characteristics between our five occupation categories using chi-square tests and ANOVA. We used Kaplan-Meier to show the survival curves for each occupation type. We also assessed log rank tests to assess the bivariate associations of each characteristic and risk of death.

We then used multivariable Cox proportional hazard regression to study the occupation type associated with the risk of death, using the Breslow method to handle ties. We tested the proportionality assumption using Schoenfeld residuals and concluded that the proportionality assumption was not violated by occupation and other variables. Because occupation is a gendered experience, we tested the interaction between sex and occupation, but the interaction was not significant. However, due to the importance of gender to employment we included stratified models by gender (tables I and II). The interaction terms between the occupations and rural/urban were significant ($p<0.05$; specific interaction term results are shown in the results section).

The Cox proportional hazard model diagnostics included Martingale residuals, which determined age and education to be used as continuous variables. We used Cox Snell to assess the model fit. Model 1 contained only occupation categories. Model 2 added sociodemographic characteristics (age, education, sex, and marital status). Model 3 added health conditions (number of health conditions, physical limitations, and depressive symptomatology). We further stratified the analysis by gender observing the effects of occupation by rural urban residence among males and females separately (tables I and II).

Results

Table III displays the descriptive statistics for the total sample (n=11 094). The mean age for the overall sample was 62 years at baseline. Across the sample, most participants were female (54.4%), were married (70.5%), had a mean education of 4.3 years, lived in an urban area (57.2%), never smoked (56.3%), had a mean of 2.3 health conditions, had no limitations (56.5%), and had high depressive symptomatology (35.7%).

Participants who worked in agriculture were slightly older than those in other occupation categories. More women reported having no main job. The second most reported job among women was in the domestic/service category. More men reported having jobs in the agriculture and production/industrial categories. The highest proportion of married individuals was reported in the agriculture category (77.8%). The highest educational attainment was reported in in the administrative/professional category (8.2 years), and the lowest educational attainment was reported in the agriculture category (1.9 years). Participants in the production/industrial category reported the highest proportion of current smokers (24.3%) and health conditions (3.3), followed by those in agriculture (21.9% and 3.2). Participants with no main job reported the highest proportion (32.4%) of high depressive symptomatology. Moreover, workers in agriculture began working at the youngest age (12 years of age) and had the largest number of years worked for pay (35 years). In contrast, workers in administration and production on average had worked the least amount of time (21 years).

Interaction between occupation and rural/urban was significant. Among the various occupation categories, agriculture emerges as a notable example, with an interaction coefficient of 0.123 ($p=0.001$). The domestic/service sector demonstrates a contrasting trend, with a negative interaction coefficient of -0.045 ($p=0.089$). This suggests that the observed impact of domestic/service work on mortality risk diminishes when transitioning

Table I

Multivariable Cox proportional hazard models predicting all-cause mortality among the MHAS participants ages 50+ between waves 1 (2001) and 5 (2018) by rural and urban residence among men

	Rural						*Urban*					
	Model 1		*Model 2*		*Model 3*		*Model 1*		*Model 2*		*Model 3*	
	HR	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*
Occupation category*												
Agriculture	1.79‡	1.24,1.82	1.63‡	1.23,1.69	1.51‡	1.13,1.72	1.11	0.92,1.24	1.15	0.94,1.22	1.17	0.93,1.25
Domestic/service	0.91	0.99,1.11	0.99	0.98,1.12	1.01	0.96,1.10	1.02	0.97,1.09	1.05	0.98,1.12	1.07	0.99,1.13
Production/industrial	1.06	0.97,1.17	1.08	0.99,1.20	1.09	0.99,1.18	1.48‡	1.37,1.59	1.35‡	1.21,1.42	1.26‡	1.15,1.37
No main job	1.13	0.99,1.25	1.12	0.93,1.22	1.07	0.96,1.17	1.03	0.92,1.23	1.05	0.93,1.19	1.10	0.94,1.14
Age			1.17§	1.06,1.17	1.14§	1.08,1.16			1.14	0.91,1.23	1.15	0.93,1.27
Marital status#												
Divorced/separated			1.20	0.98,1.32	1.22	0.98,1.30			1.33§	1.25,1.52	1.32§	1.27,1.47
Married			1.13§	1.03,1.20	1.14§	1.05,1.17			1.23	0.92,1.38	1.21	0.89,1.42
Single			1.17	0.99,1.23	1.18	0.90,1.23			1.19	0.97,1.25	1.13	0.94,1.28
Education in years			0.95	0.92,1.10	0.98	0.94,1.14			1.03	0.89,1.15	1.06	0.90,1.14
Smoking status&												
Current					1.34§	1.05,1.51					1.36§	1.11,1.48
Former					1.05	0.98,1.13					1.12§	1.05,1.21
Number of health conditions					1.22§	1.11,1.35					1.26§	1.08,1.32
Physical limitations"												
1+ limitations					1.24§	1.15 1.37					1.28§	1.10,1.33
Depressive symptomatology°°												
High					1.03	0.87,1.18					1.01	0.89,1.13

MHAS: Mexican Health and Aging Study; HR indicates estimate; * Reference category is administration/professional; ‡ denotes $p< 0.001$; § denotes $p< 0.01$; # Reference category is widowed; & Reference category is never; " Reference category is no limitations; °° Reference category is low depressive symptomatology.

Table II
MULTIVARIABLE COX PROPORTIONAL HAZARD MODELS PREDICTING ALL-CAUSE MORTALITY AMONG THE MHAS PARTICIPANTS AGES 50+ BETWEEN WAVES 1 (2001) AND 5 (2018) BY RURAL AND URBAN RESIDENCE AMONG WOMEN

	Rural						*Urban*					
	Model 1		*Model 2*		*Model 3*		*Model 1*		*Model 2*		*Model 3*	
	HR	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*
Occupation category*												
Agriculture	1.01	0.90, 1.15	1.06	0.91, 1.16	1.08	0.92, 1.19	0.98	0.84, 1.15	0.99	0.80, 1.19	1.00	0.82, 1.16
Domestic/service	1.17‡	1.10, 1.33	1.16‡	1.07, 1.29	1.14‡	1.02, 1.23	1.34§	1.05, 1.51	1.28‡	1.14, 1.42	1.26‡	1.13,1.40
Production/industrial	1.01	0.97, 1.10	1.02	0.99, 1.13	1.04	1.00, 1.08	1.13	0.86, 1.25	1.16	0.89, 1.32	1.19	0.92, 1.35
No main job	1.33§	1.10, 1.39	1.28§	1.13, 1.32	1.22‡	1.12, 1.41	1.22*	1.08, 1.34	1.26‡	1.10, 1.36	1.28‡	1.12, 1.40
Age			1.06	0.95, 1.11	1.08	0.99, 1.15			0.96	0.89, 1.15	0.99	0.92, 1.17
Marital status#												
Divorced/separated			1.15‡	1.08, 1.28	1.19‡	1.07, 1.23			1.23‡	1.10, 1.31	1.25‡	1.13, 1.30
Married			1.14‡	1.02, 1.25	1.21‡	1.03, 1.33			1.34	0.97, 1.27	1.22	0.98, 1.31
Single			1.02‡	0.98, 1.20	1.10	0.99, 1.12			1.15	0.99, 1.21	1.14	0.98, 1.23
Education in years			0.89	0.82, 1.05	0.88	0.85, 1.14			1.14	0.92,1.24	1.16	0.95, 1.30
Smoking status&												
Current					1.03	0.97, 1.35					1.05	0.97, 1.13
Former					0.95	0.87, 1.15					0.94	0.89, 1.11
Number of health conditions					1.15‡	1.09, 1.28					1.22‡	1.05, 1.31
Physical limitations"												
1+ limitations					1.14	0.99, 1.25					1.24	0.97, 1.34
Depressive symptomatology∞												
High					1.15‡	1.10, 1.25					1.12‡	1.08, 1.27

MHAS: Mexican Health and Aging Study; HR indicates estimate; * Reference category is administration/professional; ‡ denotes $p< 0.01$; § denotes $p< 0.001$; # Reference category is widowed; & Reference category is never; " Reference category is no limitations; ∞ Reference category is low depressive symptomatology.

from rural to urban settings. Additionally, the production/industrial category shows a positive interaction effect of 0.087 ($p=0.034$), implying that the influence of production/industrial occupations on mortality risk is heightened in rural contexts. The no main job group, however, exhibits a relatively modest interaction effect of 0.019 ($p=0.435$), indicating minimal variation between rural and urban areas.

Figure 1 shows the estimated Kaplan-Meier survival functions for the five occupation categories in this study. The log rank test for this analysis was significant ($p<0.001$). The agriculture category had more risk of death than any other category. The administrative/professional category had the lowest risk of death. Other categories, such as domestic/service, no main job, and production/industrial, had a similar risk of death, but less than the agriculture category and more than the administrative/professional category.

The Cox proportional hazard model estimates (table IV) show that participants in agriculture in rural areas had a higher risk of death (HR=1.45, $p<0.001$) than those in the administrative/professional category in the fully adjusted model. No other occupation category had a significant estimate in the rural strata, even after adjusting the model. Only age, sex, health conditions, and physical limitations remained as significant factors in the fully adjusted model for the association between occupation and mortality in the rural strata.

The model estimates in the urban strata (table IV) show that participants who work in the production/industrial category (HR=1.26, $p<0.001$) have the highest risk of death compared to those who work in the administrative/professional category. Participants in the domestic/service (HR=1.12, $p<0.01$) and no main job (HR= 1.22, $p<0.01$) categories have increased risk of mortality compared to the production/industrial category. Among the covariates, only age, sex, being divorced, being a former or current smoker, health conditions, physical limitations, and depressive symptomatology remain significant factors in the fully adjusted model

Table III
Distribution of characteristics by occupation type of adults 50+ in the MHAS, wave 1 (2001)

	Total sample (n=11 094)	*Agriculture (n=1 881)*	*Domestic and service (n=1 750)*	*Admin and professionals (n=2 737)*	*Production and industrial (n=2 830)*	*No main job (n=1 896)*	*p-value*
Age (mean, SD)	62.1 (9.2)	64.5 (9.8)	62.0 (9.4)	60.1 (8.4)	61.3 (8.9)	62.8 (9.2)	<0.01
Sex (n, %)							
Female	6 035 (54.4)	131 (7.0)	856 (48.9)	1 187 (43.4)	348 (12.3)	1 871 (98.7)	<0.01
Marital status (n, %)							
Divorced/separated	910 (8.2)	90 (4.8)	228 (13.0)	271 (9.9)	238 (8.4)	83 (4.4)	
Married	7 821 (70.5)	1 463 (77.8)	985 (56.3)	1 910 (69.8)	2 139 (75.6)	1 339 (70.6)	<0.01
Single	410 (3.7)	44 (2.3)	91(5.2)	175 (6.4)	65 (2.3)	39 (2.1)	
Widowed	1 953 (17.6)	284 (15.1)	446 (25.5)	381 (13.9)	388 (13.7)	435 (22.9)	
Education in years (mean, SD)	4.3 (2.4)	1.91 (2.4)	2.8 (2.9)	8.2 (5.3)	4.1 (3.3)	3.1 (2.9)	<0.01
Locality (n, %)							
Rural	4,748 (42.8)	1 576 (83.8)	600 (34.3)	684 (25.0)	923 (32.6)	929 (49.0)	<0.01
Urban	6,346 (57.2)	305 (16.2)	1,150 (65.7)	2 053 (75.0)	1 907 (67.4)	967 (51)	
Smoking status (n, %)							
Current	1 897 (17.1)	412 (21.9)	232 (13.3)	534 (19.5)	688 (24.3)	118 (6.2)	
Former	2 962 (26.7)	658 (35.0)	403 (23.0)	753 (27.5)	925 (32.7)	229 (12.1)	<0.01
Never	6 235 (56.2)	811 (43.1)	1 115 (63.7)	1 450 (53.0)	1 217 (43.0)	1 549 (81.7)	
Number of health conditions (mean, SD)	2.3 (3.2)	3.2 (3.0)	2.5 (2.2)	1.2 (1.1)	3.3 (2.8)	1.4 (1.2)	<0.01
Physical limitations (n, %)							
No limitations	6 268 (56.5)	1 100 (58.5)	854 (48.8)	1 708 (62.4)	1 681 (59.4)	937 (49.4)	0.39
One or more limitations	4 826 (43.5)	781 (41.5)	896 (51.2)	1 029 (37.6)	1 149 (40.6)	959 (50.6)	
Depressive symptomatology (n, %)							
Low	7 133 (64.3)	1 648 (87.6)	1 335 (76.3)	2 409 (88.0)	2 278 (80.5)	1 282 (67.6)	<0.01
High	3 961 (35.7)	233 (12.4)	415 (23.7)	328 (12.0)	552 (19.5)	614 (32.4)	

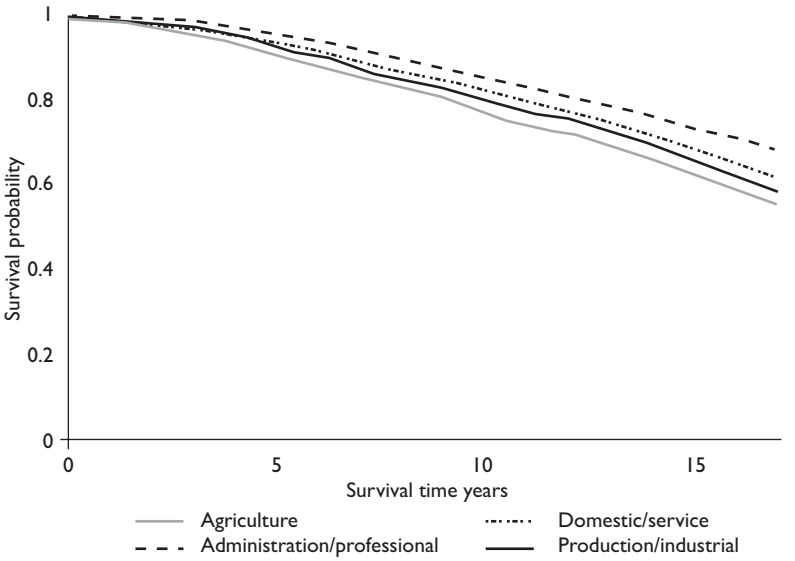
SD: Standard deviation. All percentages are column percentages
MHAS: Mexican Health and Aging Study

for the association between occupation and mortality in the rural strata.

We then observed the risk of mortality stratified by gender and rural/urban (tables I and II). Among men only the agriculture group had a significant increased risk of mortality in the rural group (HR= 1.51, $p<0.01$) and the production/industry in the urban areas (HR= 1.08, $p<0.01$). Significant factors in the adjusted model for the association of occupation and mortality are marital status and physical limitation among the rural group and smoking status and number of health conditions in the urban group. Among women, in both the rural and urban groups the domestic and no main job categories had a significant association with increased risk of death. However, only the administration and professional group had a lower risk of death among women leaving in urban areas. Depressive symptomatology and number of health conditions remained a significant factor in the risk of death for both women in rural and urban areas.

Discussion

The primary goal of this study was to examine the association of occupation and mortality by rural versus urban dwelling. We found that in both rural and urban settings participants with manual jobs, such as agriculture and production/industrial jobs, had an increased risk of mortality compared to those who held jobs in the administrative/professional category. We also found that in urban settings, participants in the domestic/service and no main job categories had a higher risk of mortality than those in the administrative/professional category.



Note: log rank test $p<0.001$
MHAS: Mexican Health and Aging Study

FIGURE 1. KAPLAN-MEIER SURVIVAL ESTIMATES FOR ADULTS AGES 50+ AND THEIR OCCUPATION BY CATEGORIES IN THE MHAS 2001

Our findings highlight health and sociodemographic factors that are associated with mortality risk in addition to occupation. For instance, our findings suggest that smoking status and depressive symptomatology are significantly associated with mortality among urban residents but not among rural residents. Smoking and depression are well-established predictors of mortality.[24,25] Number of health conditions and physical limitations seem to be stronger predictors of mortality in rural areas than urban areas. A possible explanation for this is poor access to health care in rural areas compared to urban areas, even though urban areas might experience higher prevalence of chronic health conditions.

Some of the possible mechanisms that can explain our results have to do with the context of the work environment. Occupational disparities could be a product of the varied environmental contexts that each occupation entails. First, it is well-established that the immediate work environment, such as hazardous equipment and a stressful environment, have an impact on health outcomes. This can explain why we found that both agriculture and production/industrial jobs are associated with higher risk of death both in rural and urban settings after controlling for other variables. Second, work is a source of additional advantages that have substantial impacts on health, as the workplace becomes a pool of resources. This can be applicable to Mexico, where workers get social security through their jobs, and can explain why having administrative and professional jobs is associated with lower risk of death. This is not the case for workers with manual jobs or less formal jobs, such as agriculture or domestic or service jobs. Future research endeavors could delve deeper understanding the nuanced experiences of individuals within each occupation group in both rural and urban settings by using more quantifiable descriptors of the occupational context.

Our results indicate that more manual labor in both rural and urban areas is associated with higher risk of death. Manual agriculture jobs in rural areas seem to be at a greater disadvantage compared to manual production/industrial jobs in urban areas. This can be explained by the fact that rural areas have fewer available resources than urban areas.[16] This finding suggests that more focus and protective actions need to be implemented for rural workers in Mexico. This study does not consider rural to urban migration, but future research should examine how migration from a rural to an urban setting and switching jobs from agriculture to production or sales can have an impact on health.

The employment experience in a middle-income country, such as Mexico, remains a gendered experience. In our sample, we found that participants in the no main job category were mostly women. This was also true in the domestic/service category. In the urban set-

Table IV

Multivariable Cox proportional hazard models predicting all-cause mortality among the MHAS participants ages 50+ between waves 1 (2001) and 5 (2018) by rural and urban residency

	Rural						*Urban*					
	Model 1		*Model 2*		*Model 3*		*Model 1*		*Model 2*		*Model 3*	
	HR	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*	*HR*	*95%CI*
Occupation category*												
Agriculture	1.78‡	1.68,1.88	1.34‡	1.27,1.41	1.45‡	1.34,1.56	1.16	0.93,1.39	1.12	0.92,1.32	1.10	0.90,1.30
Domestic/service	1.10	0.86,1.21	1.09	0.85,1.12	1.06	0.83,1.10	1.28‡	1.17,1.41	1.17§	1.01,1.32	1.12§	1.06,1.18
Production/industrial	1.12	0.97,1.27	1.05	0.9,1.2	1.03	0.88,1.18	1.48‡	1.37,1.59	1.32‡	1.21,1.42	1.26‡	1.15,1.37
No main job	1.23	0.99,1.38	1.06	0.91,1.21	1.04	0.96,1.12	1.37§	0.96,1,77	1.28	0.92,1.65	1.22	0.94,1.50
Age			1.15§	1.03,1.21	1.10§	1.07,1.19			1.19‡	1.1,1.28	1.21‡	1.13,1.30
Sex#												
Male			1.48	1.33,1.53	1.62	1.52,1.72			1.45‡	1.34,1.56	1.5‡	1.32,1.68
Marital status&												
Divorced/separated			1.27§	1.16,1.38	1.28§	1.13,1.42			1.45*	1.37,1.54	1.32§	1.26,1.38
Married			1.11§	1.05,1.20	1.10§	1.04,1.14			1.27	0.96,1.40	1.18	0.95,1.39
Single			1.19§	1.10,1.28	1.19§	1.12,1.23			1.19	0.99,1.31	1.15	0.91,1.38
Education in years			1.34§	1.12,1.45	1.37§	1.17,1.43			1.06*	1.05,1.34	1.02§	1.01,1.23
Smoking status"												
Current					1.16	0.97,1.35					1.31‡	1.20,1.44
Former					1.07	0.92,1.24					1.11‡	1.03,1.20
Number of health conditions					1.24‡	1.15,1.32					1.21§	1.17,1.24
Physical limitations∞												
1+ limitations					1.35‡	1.22,1.48					1.25§	1.10,1.38
Depressive symptomatology∅												
high					1.05	0.91,1.19					1.23§	1.15,1.25

MHAS: Mexican Health and Aging Study; HR indicates estimate; * Reference category is administration/professional; ‡ denotes $p< 0.001$; § denotes $p< 0.01$; # Reference category is femele; & Reference category is widowed; " Reference category is never; ∞ Reference category is no limitations; ∅ Reference category is low depressive symptomatology.

ting, participants in the domestic/service category had a higher risk of death than those in the administrative/professional category. Similarly, participants in the no main job category in urban areas had a higher risk of mortality than those in the administrative/professional category. A similar trend, though not significant, was observed in rural areas. Women who work in the domestic/service field or who are not working but might hold an unpaid job as a housewife or housekeeper share similar job roles, for example, cleaning, caregiving, organizing, and planning, which might result in different health benefits or disadvantages compared to men. The context of these jobs might look different in a rural setting, where the infrastructure and resource availability places more physical demand on women and impacts their health further.[26] Moreover, previous studies using the MHAS data have found that the association between occupation and health is stronger for women than men, with or without controls for education and wealth and when studying the physical demands of work related to mobility limitations.[6] Future research should investigate the health consequences of paid and unpaid female employment through a deeper esploration of occupation characteristics that affect women more than men. We still do not know which mechanisms of these jobs are affecting women's health, especially in the context of a middle-income country were the education and employment gender gaps are narrowing.[27]

Rural and urban differences are clear for mortality associated with occupation. Healthcare access could be an important factor that is differently experiences in both rural and urban areas in Mexico. We must interpret our results in light of the Mexican social and economic context during our study period. During this period there was the implementation of public insurance coverage for all of Mexico known as *Seguro Popular*. Starting in 2003 and reaching wide coverage in 2012, the program allowed all uninsured Mexicans to access and utiliza-

tion of the healthcare system. However, this coverage is more widespread in cities. Consideration of the context of rural and urban areas and its differences could be a potential future research endeavor that might be worth exploring.

This study comes with several limitations. First, although previous studies have demonstrated that the MHAS death reports yield similar mortality estimates as life tables,[18] reports of death in our analytic sample may not represent mortality as accurately. Second, we are categorizing occupation based on similar activities, roles, and educational requirements, which may not show the full extent of the mechanisms behind the relationship between occupation and mortality. Currently, we are not able to categorize occupations by a job's physical or cognitive demand in the MHAS. Lastly, we did not consider time-varying variables for this analysis, but it will be important to consider changes in employment and duration in future studies. Third our depiction of rural and urban community sizes is limited to measures available in the MHAS. We recommend this study to expand to other categorizations of rurality or urbanicity that capture the heterogeneity of these areas based on other markers. While our analysis sought to capture trends and patterns across different occupation categories within these rural areas, the significant differences in the characteristics of communities with varying population sizes may have introduced confounding factors that we were unable to fully account for in our analysis.

The problem of selective attrition is important to this study. Selective attrition can be cause by the phenomenon of increased or decrease life expectancy experiences by this population throughout the years. These effects are linked to socioeconomic status. Like in high income countries, Mexico has also followed increased trends in life expectancy. There is high life expectancy among older adult in Mexico, particularly among low-SES individuals with life expectancy declining with increasing education or in large cities.[28] We recommend further evaluation of education and occupation as determinants of cohort differences in the context of SES gradients. With increasing life expectancy and the low educational attainment experienced in a low-middle income setting, it is to expect that increases in life expectancy could have a role in recent cohorts experiencing higher cognition. Studies have shown in Mexico the increases in life expectancy have not been followed by a compression of disability, rather older Mexican adults in more recent cohorts are living longer but with increased physical limitation and disablement.[29] Physical limitation could potentially limit individuals to the point of exiting the labor force. At the same time evidence shows that Mexican adults work even during old age and that this has played a positive role in aging outcomes such as cogntition.[30] Working in old age is not uncommon in a country like Mexico where the lack of economic support for older adults forces them to continue to work. This could result in benefits to health in old age. The further exploration of the impact of life expectancy and its role in health outcomes as it relates to socioeconomic determinants should be conducted in the Mexican context.

Despite these limitations, this analysis can be useful to characterize the rural and urban differences in mortality and other health outcomes in relation to lifetime occupation. This analysis raises intriguing questions that are worth additional research. Will the health differential between Mexican rural and urban areas continue to increase as demographic changes occur? What policies can be put in place to diminish the health disadvantage of vulnerable groups? By finding answers to these questions, policy makers could identify areas of need among the Mexican population undergoing occupational changes, rural to urban migration, and rapidly aging.

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