Research Article

Stability and Change in Activities of Daily Living Among Older Mexican Americans

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Received April 21, 2015; Accepted September 7, 2015

Decision Editor: Stephen Kritchevsky, PhD

Abstract

Background. Longitudinal studies of activities of daily living (ADL) in older adults have identified numerous factors associated with declining ability. Analyses based on population averages may not observe distinct subgroups whose ADL trajectories differ.

Methods. We used latent class models to identify subgroups of trajectories in a sample from the Hispanic Established Populations for Epidemiologic Study of the Elderly, a population-based study of noninstitutionalized Mexican Americans aged 65 and older from five Southwestern states (n = 2584).

Results. Three distinct trajectories of ADL limitations were identified and characterized as stable, delayed, and rapid ADL increase. Sex (female), diabetes, and arthritis were associated with increased odds of membership in the delayed and rapid groups compared with the stable group. Stroke had a differential magnitude of effect on ADL limitations across the stable (β = 1.11, p < .001), delayed (β = 0.52, p < .001), and rapid groups (β = 0.12, p < .05). Hip fracture was associated with increased limitations in the stable group (β = 1.27, p < .001) but not in the rapid group. Church attendance was associated with fewer limitations in all groups with a larger effect in the stable group (β = −0.87, p < .001) compared with the rapid group (β = −0.10, p < .05).

Conclusions. Substantial heterogeneity exists in changes in ADL disability over time among older Mexican Americans. Attempts at maintaining function may benefit from targeting reductions in comorbidities and acute health events associated with disability.

Keywords: Disability—Heterogeneous transitions—Trajectories—Hispanic

Increases in life expectancy over the last half century have corresponded with increases in life with progressive disability among older adults (1,2). Disability may be characterized as difficulty in performing normal, daily activities due to limitations imposed by health (3). Preventing disability and delaying declines in physical function in older adults can facilitate independence, improve quality of life, and reduce the burden of institutionalization and mortality (4–6).

Aging is a dynamic process uniquely affecting each individual. Significant variation in self-reported health and disability within age groups has been reported, even at very old ages (85 years and older) (7). Numerous risk factors associated with disability have been identified including increased age, gender (female), diabetes, heart disease, stroke, heart attack, and hip fracture (8–11). In addition, psychiatric disorders, depression, and impaired cognitive status have been associated with increased ADL limitations (12,13). Education, on the other hand, has been associated with reductions in disability (10,14).

Research on the association of social factors with disability is more mixed. In a prospective study of 954 older adults, social activity was associated with a 43% decreased risk of developing ADL limitations and a 31% reduced risk of mobility disability (15). A review from 1999 found that low frequency of social contacts was associated with declines in functional status in three studies but was not ratable in four others (13). A study in Norway found that increases in social activity were associated with decreases in ADL limitations while increased social networks were not (16). A study
of older adults in Taiwan found that leisure activities were positively associated with maintained functional status, whereas reduced activities and decreased social networks were associated with chronic disability (17). Similarly, a Swedish study found evidence of subjective support and reduced disability but only among chronically disabled older adults (18).

It has been reported that Hispanic elders have greater rates of ADL disability than non-Hispanic Whites (19), whereas others have shown that Hispanics are more likely to report similar ADL restrictions but increased limitations in instrumental ADL compared with non-Hispanic Whites (20). Higher rates of physical impairment at older ages among Hispanics are of particular importance as Hispanics represent the largest and fastest growing minority group in the United States (21).

A difficulty in the identification of predictors of good functional status over the long-term among Hispanics is a lack of longitudinal data on under-represented minorities with relevant predictors. An additional challenge in identifying factors associated with decline or maintenance of ability is the heterogeneous composition of older adult populations encompassing broad variations in health status, mobility, and social support (7,22). We address part of these challenges by using data from the Hispanic Established Population for the Epidemiological Study of the Elderly, an ongoing 20-year study of older Hispanics, and employ latent class models to identify subgroups (or classes) of participants with distinct trajectories of change in disability over time. In this research, we describe the psychosocial, health, and lifestyle factors associated with maintenance of ADL ability in Mexican-origin elders. We hypothesize that, given the reported heterogeneity of disability among older adults, there will be subgroups of distinct trajectories of disability among older Mexican-origin adults that differ from the overall group mean due to heterogeneity of characteristics within the sample. We also hypothesize that the effects of both psychosocial and physical health factors on ADL change will vary by trajectory membership due to the expected differences in trajectory group characteristics.

Materials and Methods
Sample
The study sample was drawn from participants in the Hispanic Established Populations for Epidemiologic Study of the Elderly (H-EPESE). The H-EPESE is an ongoing population-based study of 3,050 noninstitutionalized Mexican Americans aged 65 and older at baseline (1993–1994) from five Southwestern states (Texas, California, New Mexico, Colorado, and Arizona). Eight waves of data have been collected (1993–1994 n = 3,050; 1995–1996 n = 2,438; 1998–1999 n = 1,981; 2000–2001 n = 1,682; 2004–2005 n = 1,167; 2006–2007 n = 921; 2010–2011 n = 659; and 2012–2013 n = 444). Respondents were interviewed in Spanish or English. Details regarding the methods have been described elsewhere (23,24). Our sample includes all respondents aged 65–89 years who had complete data for included variables at baseline regardless of disability status (n = 2,584). Excluded subjects had higher rates of stroke, hip fracture, depression, and cognitive impairment than those of the main analytical sample. In addition, because the presence of disability at initial assessment might predispose a participant to increased limitations over time, we also examined a subset of respondents who had no ADL limitations at baseline (n = 2,230). We refer to this subset as disability-free in our results. All research protocols and informed consents were approved by the University’s Institutional Review Board.

Dependent Variable
Disability status was ascertained through self-report of seven items on a modified version of the Katz ADL scale (25). The ADL scale assessed the degree to which the respondent needed assistance in walking, transferring from a bed to a chair, grooming, dressing, bathing, feeding oneself, and toileting. The items were scored as 0 for no help needed and 1 if they needed help or were unable to perform the activity. The individual item scores were then summed into a single measure of ADL limitations (range 0–7).

Covariates
Cognition
Cognitive function was measured using the Mini-Mental State Examination (MMSE) (26) during each interview. The MMSE is composed of responses to a standard battery of memory and reasoning problems that include orientation, attention, short-term recall, language, and the ability to follow simple instructions. Although the common cutoff for impairment on the MMSE is 24, significant performance differences between Hispanics and non-Hispanic Whites have been noted (27) suggesting a modified cut point. The MMSE score was dichotomized to reflect cognitive impairment (MMSE < 22) which reflects the lower educational attainment and distribution of MMSE scores in this population and represents the lower bound of normal cognitive function (12).

Health Conditions
We included major health conditions associated with functional decline (11–13). Hypertension, heart attack, stroke, diabetes, arthritis, and hip fracture were ascertained through self-report by asking the respondents (1) “Has a doctor ever told you that you had . . . ” during the baseline interview and (2) “Since we last spoke . . . told by a doctor that you . . . ” during follow-up. Answers were coded as yes or no. We also included four weight categories based on body mass index (BMI) (28): underweight (BMI < 18.5), overweight (BMI ≥ 25 and BMI < 30), and obese (BMI ≥ 30) compared with normal weight (BMI ≥ 18.5 and BMI < 25).

Psychosocial Factors
We included two psychosocial factors in the analyses. We included depressed mood because it is associated with disability (29). Depressive symptoms were assessed through the Center for Epidemiologic Studies Depression Scale (CES-D) (30) which has a range from 0 to 60, with higher scores reflecting increased depressive symptoms. A cut point of 16 was used to denote depressive symptoms. Church attendance was also included as a measure of social integration. Attendance was coded as one or more times per month, yes or no.

Other Covariates
Covariates included gender (female vs male), marital status (currently married vs not), language of interview (Spanish vs English), nativity (U.S. born vs foreign born), high school education (vs less than high school), and current smoking status (yes vs no). Financial strain was assessed through the respondent’s reporting a “great deal” of difficulty meeting monthly payments and coded yes or no.

Statistical Analyses
All analyses were performed for the complete cohort as well as for the disability-free subset. Demographic characteristics were examined in total and disability-free subset. Next, latent class mixture
Results

Baseline characteristics of the total sample and the disability-free subsample (no ADL limitations at baseline) are shown in Table 1. The total sample had a mean age of 73 years (SD 5.9) and was mostly women (58%). The subsample was similar in all characteristics. Average age at each assessment period (baseline to wave 9) was 73, 75, 77, 79, 82, 84, 87, and 89 years with an average attrition of 23% between assessments for the complete sample and 22% between assessments for the disability-free subset.

Figure 1 displays estimated ADL limitations from a model based on a single population average and the three distinct trajectory groups (stable, delayed disability, rapid disability) for the total sample (left panel) and the subsample (right panel). The stable group starts at an average ADL score of 0 and shows little increase in limitations until age 82. The delayed disability group starts with a predicted average ADL limitation of 0.23 and shows little increase until age 82 at which point predicted ADL limitations increase to 3. The predicted average number of ADL limitations for the rapid disability group was 1.03 at baseline and increased steadily until age 89. Estimates based on a single population average ranged from 0.26 ADL limitations at baseline to 1.78 limitations at last follow-up. The mean posterior probabilities for group assignment in the total sample were acceptable for the stable (.84), delayed (.75), and rapid disability (.87) groups. Wald tests comparing slopes showed significant differences between groups. This approach was applied examining the probability of group membership by year of age, and we examined the difference in age distribution by group finding no significant differences between groups. This approach was applied separately for the complete sample and the disability-free subsample.

| Table 1. Baseline Characteristics of Total Sample and Subsample With no ADL Limitations From the H-EPESE (1993) |
|---------------------------------|------------------|------------------|
|                                | Total Sample     | Subsample        |
|                                | Mean (SD) or Percent | Mean (SD) or Percent |
| N                               | 2,584            | 2,380            |
| Age (years)                    | 72.68 (5.87)     | 72.37 (5.7)      |
| Female                         | 58.24            | 57.73            |
| High school                    | 10.14            | 10.50            |
| Overweight                     | 40.56            | 40.80            |
| Obese                          | 29.72            | 29.62            |
| Diabetes                       | 27.01            | 26.18            |
| Arthritis                      | 45.07            | 44.13            |
| Married                        | 56.85            | 57.86            |
| Church: monthly                | 65.09            | 66.18            |
| Financial strain               | 21.56            | 20.29            |
| Hypertension                   | 40.63            | 39.71            |
| Heart attack                   | 8.36             | 7.52             |
| Stroke                         | 4.64             | 3.70             |
| Hip fracture                   | 2.79             | 2.14             |
| CES-D >16                      | 22.45            | 20.76            |
| MMSE <22                       | 17.45            | 15.92            |

Notes: CES-D = Center for Epidemiologic Studies Depression Scale; H-EPESE = Hispanic Established Populations for Epidemiologic Study of the Elderly; MMSE = Mini-Mental State Examination.

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significant differences between the total sample and the stable trajectory ($X^2 = 2,467.66, p < .001$), the delayed trajectory ($X^2 = 538.69, p < .001$), and the rapid trajectory groups ($X^2 = 12.49, p < .001$).

The right panel of Figure 1 shows estimated ADL limitations for the disability-free subsample. Because these are estimates from the regression equations, values at baseline are not equal to zero. The stable group showed little change until age 89 with a final predicted number of ADL limitations of 0.8. The rapid disability group climbs steadily to four ADL limitations by age 89. The estimates based on a single population average ranged from 0.2 at baseline to 1.8 limitations by age 89. The delayed disability group follows the single population estimates until age 87 and reaches 3.1 ADL limitations by age 89. The plotted confidence intervals suggest that the three trajectory groups are distinct from each other until age 89 when the rapid and delayed groups overlap. The mean posterior probabilities for group assignment in the disability-free subsample were .85 in the stable group, .77 in the delayed group, and .91 in the rapid disability group.

Table 2 presents the results of the multinomial logit models predicting odds of group membership (stable ADL group is referent) in the fully adjusted models for the full sample (left panel) and the disability-free subsample (right panel). Women were more than twice as likely to be in the rapid group and 78% more likely to be in the delayed disability group compared with the stable group. Diabetes was also associated with increased odds of membership in the delayed disability group (odds ratio [OR] 1.81, 95% confidence interval [CI] 1.09–2.53) and rapid disability group (OR 2.44, 95% CI 1.37–3.51) compared with the stable group. Obesity was associated with increased odds of membership in the delayed group (OR 2.74, 95% CI 1.54–3.95) but was not associated with odds of membership in the rapid group. In the disability-free subsample, diabetes was associated with an increase in odds of membership in the rapid disability group (OR 1.98, 95% CI 1.29–2.67) and obesity was associated with increased odds of membership in both the rapid group and the delayed group compared with the stable group (OR 1.98, 95% CI 1.12–2.50 and OR 2.55, 95% CI 1.37–3.73, respectively).

The results of the fully adjusted zero-inflated Poisson models are shown in Table 3 for the main sample (left panel) and the disability-free subsample (right panel). The β coefficients indicate the estimated change in the log count of ADL limitations associated with the presence of each covariate at each measurement point. The exponentiated β coefficients are interpreted as change in ADL limitations associated with each covariate. In the main sample, stroke was associated with increased limitations across all trajectory groups. This was highest among the stable trajectory group where stroke was associated with an increase of nearly three ADL limitations ($β = 1.11, p < .001$). In the stable trajectory group, heart attack, hip fracture, a CES-D score > 16, and an MMSE score < 22 were associated with increased limitations. In the delayed disability group, financial strain and hip fracture both were associated with increases in ADL limitations ($β = 0.25, p < .001$ and $β = 0.27, p < .01$, respectively). Church attendance was associated with decreases in ADL limitations in the stable ($β = −0.87, p < .001$), delayed ($β = −0.43, p < .001$), and rapid trajectory groups.

Figure 1. Estimated activities of daily living (ADL) limitations based on a single population average (double line) and for the stable (solid line), delayed (dashed line), and rapid (dotted line) ADL limitation groups in the main sample (left panel) and the disability-free subsample (right panel).

Table 2. Multinomial Logit Models Predicting Trajectory Group Membership Into Delayed and Rapid Trajectory Groups Compared With the Stable Group for the Main Sample (left panel) and the Disability-free Subsample (right panel) in the H-EPESE (1993–2012)

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Main Sample</th>
<th>Subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delayed</td>
<td>Rapid</td>
</tr>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Female</td>
<td>1.78 (1.14–2.41)</td>
<td>2.24 (1.53–2.95)</td>
</tr>
<tr>
<td>High school</td>
<td>0.98 (0.44–1.51)</td>
<td>0.78 (0.38–1.18)</td>
</tr>
<tr>
<td>Over weight</td>
<td>1.23 (0.71–1.75)</td>
<td>0.81 (0.53–1.09)</td>
</tr>
<tr>
<td>Obese</td>
<td>2.74 (1.54–3.95)</td>
<td>1.37 (0.85–1.90)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.81 (1.09–2.53)</td>
<td>2.44 (1.64–3.23)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1.59 (1.07–2.12)</td>
<td>1.94 (1.37–2.51)</td>
</tr>
</tbody>
</table>

Notes: CI = confidence interval; H-EPESE = Hispanic Established Populations for Epidemiologic Study of the Elderly; OR = odds ratio.
Table 3. Zero-Inflated Poisson Models (β coefficients) Predicting Increases in ADL Limitations as a Function of Age for Each Trajectory Group for the Main Sample and Disability-free Subsample in the H-EPESE (1993–2012)

<table>
<thead>
<tr>
<th></th>
<th>Main Sample</th>
<th>Subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stable</td>
<td>Delayed</td>
</tr>
<tr>
<td>Married</td>
<td>0.22</td>
<td>0.03</td>
</tr>
<tr>
<td>Church</td>
<td>-0.87***</td>
<td>-0.45***</td>
</tr>
<tr>
<td>Financial strain</td>
<td>0.00</td>
<td>0.25***</td>
</tr>
<tr>
<td>Heart attack</td>
<td>0.58***</td>
<td>0.07</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.11***</td>
<td>0.52***</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>1.27***</td>
<td>0.27**</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.00</td>
<td>-0.11</td>
</tr>
<tr>
<td>MMSE &lt; 22</td>
<td>1.16***</td>
<td>0.51***</td>
</tr>
<tr>
<td>CES-D &gt; 16</td>
<td>0.67***</td>
<td>0.44***</td>
</tr>
</tbody>
</table>

Notes: ADL = activities of daily living; CES-D = Center for Epidemiologic Studies Depression Scale; H-EPESE = Hispanic Established Populations for Epidemiologic Study of the Elderly; MMSE = Mini-Mental State Examination.

* p ≤ .05. ** p ≤ .01. *** p ≤ .001.

groups (β = −0.10, p < .05). In the disability-free subsample (Table 3, right panel), stroke, cognitive impairment, and depression were associated with increased ADL limitations in each trajectory group, whereas church attendance was associated with reduced limitations in each group. Hip fracture was associated with significant increases in ADL limitations in the stable and delayed group (β = 1.57, p < .001 and β = 0.47, p < .01, respectively) but not in the rapid group.

We also performed sensitivity analyses to examine the impact of attrition and mortality. The probabilities of death at next assessment by age at prior assessment for each trajectory group for both the main sample and the disability-free subsample are shown in Supplementary Figure 1. In both the main sample and the disability-free subsample, the probability of death increases with age with no significant difference between trajectory groups, suggesting that differences in functional assessments between groups are not likely due to selective mortality.

As a further test, we combined mortality and attrition into a single indicator and modeled a joint trajectory of ADL limitations. These models showed a low joint probability of membership in the rapid limitation group conditional on low attrition in the main sample and in the disability-free subsample. There were no differences in group memberships conditional on higher rates of attrition. Two additional sets of models examined binary outcomes: any ADL limitation as well as any ADL limitation or death combined into a single variable. Both sets of models identified three trajectories analogous to the main analysis. These sensitivity analyses suggest that although death and attrition may contribute to some of the variation between groups, differential mortality and attrition were not solely responsible for differences in ADL limitations between trajectory groups.

Discussion

Substantial heterogeneity in disability over time was evident in our examination of the H-EPESE. Using latent class mixture models, we tested our hypothesis that subgroups with distinct patterns of change would be discernable and found that three distinct trajectory groups were in both the total sample and the disability-free subset: stable, delayed increase, and rapid increase in ADL limitations. In our analysis, none of the estimated trajectories closely approximated the overall population average for the duration of the study.

It has been reported that Hispanics experience more activity limitations and spend longer lives in disability than non-Hispanic Whites (19,34,35). We found that only a subset of Mexican-origin older adults, the rapid ADL limitation group, experienced sustained periods of disability (one or more ADL limitations) from age 73 until age 87. In contrast, the stable trajectory group experienced no disability (less than one ADL limitation) over the same range. It is possible that previous reports of average effects are driven by the presence of ADL limitations in a subset of the Hispanic population and are not representative of the population as a whole. Indeed, when the stable and delayed trajectory groups are combined, our results suggest that many Mexican-origin older adults (about 80%) experience few ADL limitations until about age 82.

An important aspect of our analysis is the ability to describe subgroups at particular risk of ADL limitations and to identify risk factors. The rapid ADL increase group had relatively high rates of chronic conditions (obesity, diabetes, and arthritis). Importantly, the presence of diabetes at baseline was associated with a more than twofold increase in odds of membership in the rapid group. Given the relatively high prevalence of diabetes among Mexican-origin older adults, these results suggest that, by age 73, a substantial proportion is at risk of rapid increase in ADL limitations over the next 10 years. The degree to which this increased risk was due to duration of disease exposure or poorly controlled disease could not be ascertained with the current data.

Previous reports on the H-EPESE population found that increased limitations were associated with increased age, low education (less than high school), marital status (not married), diabetes, stroke, and depressive symptoms (11,12). Our results suggest that heterogeneity within the sample limits the broad interpretation of previous findings. For example, similar to other reports, we found that depressive symptoms increase the risk of activity limitations; however, this effect was only observed in the stable and delayed disability groups and not in the rapid disability group in the main sample. Heart attack also had a differential impact across groups only having a significant effect in the stable group in both the main and subsample. Population average approaches are unable to observe these subgroup variations and may lead to biased interpretations. The results of the disability-free subsample analysis were consistent with those of the main sample. The presence of different trajectories in the subsample provides support for the findings from the main sample and further suggests that trajectories of limitations were not merely extensions of ADL limitations at study entry.
The association of stroke with increased ADL limitations was expected as stroke is a leading cause of disability (36) and a leading contributor to years lived with disability (37). Although stroke was a significant predictor of increased ADL limitations in all groups in our analyses, the results showed a gradient in the magnitude of effect with the largest impact in the stable trajectories and the smallest in the rapidly increasing groups. This gradient suggests that in the relatively healthy, stable groups, a single event contributes to a greater loss of function than in groups that have more competing conditions.

The lack of significant contributors to ADL limitations in the rapid disability group was unexpected. In both the total sample and disability-free subsample, the baseline profile of the rapid disability group, including older age, high rates of diabetes, arthritis, stroke, hip fracture, depressive symptoms, and impaired cognition, suggests that this group is already frail. It is possible that, given the groups’ general frailty, there is little that individual events contribute to disability over time.

While an association of hip fracture with increased ADL limitations was expected, the effect was confined to the stable and delayed groups. Although many recover independence within 6 months, as many as 30% of those experiencing fracture will be in a nursing home at 12 months (38) after the fracture. Additionally, rehabilitation following hip fracture can be slow, particularly in elderly patients (39). It is possible that differential access to hospital and rehabilitation across the groups contributed to this observed variation in effect. It is important to note that the magnitude of effect of hip fracture in the stable group was quite large, an estimated increase of 3.3 limitations, underscoring the importance of prevention.

Although low levels of education have been associated with poor health outcomes, increased mortality, and increased functional limitations (40), we found no indication of an education effect in our analysis. It is possible that the levels of education in this sample were below the threshold where any benefit could be observed.

Although many of the covariates in our analysis were associated with functional decline (increased ADL limitations), a notable exception was religious attendance. The association of monthly church attendance with reduced ADL limitations persisted across trajectory groups in both the main sample and the disability-free subsample. Religious attendance has been found to have a protective effect on activity limitations in older adults in other studies (41,42). The reasons for this positive effect are unclear. Although those with functional limitations may find religiosity a source of coping with disability, it is also possible that regular attendance and associated increased use of prayer may influence ADLs by promoting feelings of optimism and increasing motivation to maintain function. Similarly, regular attenders of church services may be more engaged in their community and more likely to adhere to better health practices and receive more encouragement to remain physically active than nonattendees.

Limitations

There are several important limitations to this study. The presence of health conditions in our study was self-reported and may not accurately reflect the health of the individual respondents. However, self-report has been found to be relatively reliable in other research (43). We were also unable to assess the severity of any health factor such as stroke, heart attack, hypertension, or diabetes. We were also unable to assess the degree to which a respondent may have received rehabilitation therapy following a potentially disabling event such as stroke or hip fracture. Another limitation was due to the rather coarse measure of time in the H-EPSEX study. Assessments were 2 to 3 years apart, which limited our ability to capture more nuanced variations in ADLs, particularly patterns of recovery or decreases in limitations that may occur in the interim between assessments.

Conclusions

The identification of heterogeneous subgroups highlights the differential effect of predictive factors in groups with different trajectories of disability. Sustained, good physical function among older Mexican-origin adults is particularly challenged by risk factors such as diabetes, heart attack, and stroke. While many factors contributed to increased limitations, the large magnitude of effect of these acute health events stand out as potential targets for interventions. The protective effect of church attendance warrants further exploration.

Supplementary Material

Please visit the article online at http://gerontologist.oxfordjournals.org/ to view supplementary material.

Funding

This work was supported by grants from the National Institutes of Health (grant numbers R01 AG010939, R01 AG017638, R24 HD065702, and P30 AG024832).

Conflict of Interest

No potential conflicts of interest exist for any of the authors prior to the month of this submission.

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