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Perceived ethnic discrimination and cognitive function: A 12-year longitudinal study of Mexican-origin adults

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ABSTRACT

Objectives: Hispanic/Latinx adults are at increased risk for cognitive impairment, and it is critically important to identify modifiable risk factors for cognitive impairment in this population. We addressed two key questions: (1) How does perceived discrimination change across middle adulthood? And, (2) How are discrimination and the trajectory of discrimination associated with cognitive function?

Methods: We used data from 1110 Mexican-origin adults between 26 and 62 years old (63% female; 85% born in Mexico). Participants completed a perceived ethnic discrimination scale five times across 12 years and completed cognitive assessments in the last wave, which were composited into a measure of overall cognitive function. We used latent growth curve models to estimate the longitudinal trajectory of perceived ethnic discrimination and growth mixture models to identify sub-groups of change trajectories. We evaluated whether patterns of perceived discrimination trajectories, baseline, intermediary, and concurrent discrimination predicted cognitive function at the last wave.

Results: Perceived ethnic discrimination decreased over time on average. Significant individual differences in within-person change revealed two change trajectory classes: Stable Low and High Declining. The Stable Low class had better cognitive performance compared to the High Declining class, but this effect was not robust to educational attainment. Perceived discrimination at the last wave was associated with worse cognitive function, and this effect remained after accounting for covariates.

Conclusions: This study is among the first to evaluate changes in perceived ethnic discrimination in a sample of Mexican-origin adults and their associations with cognitive function. The results highlight the need for more research to better understand the role of discrimination and other social stressors on cognitive health outcomes.

1. Introduction

The United States' aging population is becoming more diverse with racial and ethnic minoritized adults suffering a greater incidence of Alzheimer's disease and related dementias (ADRD) compared to non-Hispanic whites (Ortman et al., 2014). The Hispanic/Latinx (hereafter, Latinx) population is the fastest growing in the United States, with a projected increased prevalence of ADRD in Latinxs (Grayson and Velkoff, 2010; Matthews et al., 2019). It is therefore critical to evaluate the role of psychosocial risk factors for reduced cognitive health within this population. Perceived discrimination has been linked with physical and mental health outcomes and preliminary evidence shows that it may also be a risk factor for reduced cognitive function. It is also unknown if differences in perceived discrimination across adulthood im-

pact cognitive function. In this study, we evaluated the association between longitudinal experiences with perceived ethnic discrimination and cognitive function in a sample of Mexican-origin adults during midlife, a critical period of the lifespan for cognitive health (Livingston et al., 2017).

The Latinx population is diverse in multiple ways, including socio-economically, demographically, culturally, and ethnically. Indeed, González et al. (2015) showed that there are differences in cognitive function by Latinx heritage group (i.e., Central American, Cuban, Dominican, Mexican, Puerto Rican, South American). Understanding correlates of cognitive health among Latinxs from specific heritage backgrounds can therefore elucidate relevant risk factors within this population. Mexican-origin adults constitute 62% of the Latinx population living in the U.S. (Noe-Bustamante et al., 2017). Thus, a within-population

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study focused on Mexican-origin adults allows for a better understanding of risk factors for reduced cognitive health in the largest Latinx group in the U.S. We leveraged data from adults of Mexican origin living in California, United States, and focused on perceived ethnic discrimination as a relevant social stressor known to undermine cognitive function in racial and ethnic minoritized adults (Barnes et al., 2012; Zahodne et al., 2017a, 2017b).

Midlife is a critical period in the lifespan that remains largely unexamined, despite being a developmental period when individuals must balance multiple social roles while simultaneously managing life transitions, challenges, and opportunities (Infurna et al., 2020; Lachman, 2004). Midlife may thus be a critical time to evaluate early precursors of disparate health outcomes in late life among Latinx adults. Yet, relatively little is known about how social experiences, such as experiences with discrimination, during this period of life are associated with markers of cognitive health that are predictive of late-life cognitive health outcomes in this population. We focused on the association between perceived ethnic discrimination and cognitive function among middle-aged adults of Mexican origin.

Perceived ethnic discrimination refers to people's perceptions that they are treated badly or unfairly in their everyday life because of their ethnicity. These experiences are ethnically relevant sources of stress (Clark et al., 1999) that have been associated with poor mental and physical health outcomes in Latinx adults (Caplan, 2007; Gallo et al., 2009; Stein et al., 2019). The limited extant literature suggests that perceived discrimination is negatively associated with cognitive function among Black adults (Barnes et al., 2012; Johnson et al., 2020). Although one study found no associations between discrimination and cognition in Latinx adults, they did not specifically evaluate associations by Latinx heritage and their assessment of discrimination did not ask about discriminatory experiences due to being Latinx (Zahodne et al., 2017a, 2017b). Most recently, Lamar et al. (2021) found that higher scores on a composite index of contextually-related stressors that included perceived discrimination was associated with lower cognitive function in older (average age = 70) Latinx adults.

Glymour and Manly (2008) proposed a life-course theoretical framework in which discrimination experienced throughout one's life is one explanatory mechanism of cognitive health inequities, in part through both psychological and physiological processes. Perceived discrimination is a powerful social stressor that activates psychological and physiological stress responses that may subsequently produce chronic stress without proper intervention (Clark et al., 1999). Indeed, greater perceptions of discrimination are associated with poorer psychological well-being, including greater anxiety, anger, loneliness, and depressive symptoms (e.g., Nadimpalli et al., 2015; Stein et al., 2019; Sutin et al., 2015), some of which have been shown to mediate the link between perceived discrimination and cognition (e.g., Zahodne et al., 2017a, 2017b). Perceptions of discrimination are also associated with stress-related physiological pathways such as elevated cortisol and systemic inflammation (e.g., Adam et al., 2015; Friedman et al., 2009). These biological markers of stress are associated with reduced cognitive function (Lupien et al., 2009) and have been shown to mediate the perceived discrimination-cognition link. For example, systemic inflammation, indexed by C-reactive protein, mediated the concurrent association between perceived discrimination and episodic memory among Black participants from a U.S.-representative study (Zahodne et al., 2019).

From a stress perspective, the duration and timing of experiences with discrimination are critical to examine (McEwen, 1998). Experiences of stress can be adaptive if short-lived, but detrimental to health if enduring and inescapable (McEwen, 1998, 2007). For example, prior work has shown that greater average levels of perceived stress were associated with reduced cognitive function, whereas changes in perceived stress over time were not (Aggarwal et al., 2014; Munoz et al., 2015). This pattern indicates that chronic or consistent levels of a stressor like

perceived discrimination may have more detrimental effects on cognition than changes over time. To better understand the role of perceived discrimination on cognition, it is therefore necessary to evaluate perceived discrimination longitudinally and evaluate if both the average level and changes in this stressor are associated with cognitive function.

In addition to extending our understanding of the association between discrimination and cognitive function in midlife adults of Mexican origin, we aimed to evaluate longitudinal change patterns of discrimination. Although prior theoretical propositions suggest that long-term exposure to experiences of discrimination may be detrimental to cognitive health outcomes (Clark et al., 1999; Glymour and Manly, 2008), studies have yet to explicitly evaluate this association. We leveraged longitudinal reports of perceived ethnic discrimination across five waves spanning 12 years to address this question. To date, few studies have incorporated longitudinal assessments of discrimination in adulthood, but there have been some studies of change in discrimination across childhood and adolescence. This literature reveals mixed results with some studies showing that discrimination increased during middle school and declined through high school (Hughes et al., 2016). Among the adolescent participants in the California Families Project used in the current study, however, ethnic discrimination was stable in middle school and increased during the transition to high school (Stein et al., 2019). Differences in place of residence (e.g., California vs. other states) and ethnic background (e.g., multi-ethnic vs. Mexican-origin) may have contributed to inconsistent findings. Given the heterogeneity within the Latinx population, it is thus valuable that the current study focuses primarily on changes in perceived ethnic discrimination in Mexican-origin adults living in California.

In the limited longitudinal studies of discrimination in adulthood, one study averaged discrimination scores across two waves (Fuller-Rowell et al., 2018), and another study created a single latent score based on two waves of data across a three-year interval (Upchurch et al., 2015); neither of these studies examined associations with cognitive health (they examined physical health outcomes). We extend this literature by modeling baseline level and change over time in perceived discrimination to discern the pattern of change across 12 years. Further, because experiences of discrimination may be idiosyncratic and some individuals may experience more, less, or variable discrimination, we evaluated if there are distinct patterns of change in discrimination experiences across time. The ultimate goal of this study was to develop a nuanced understanding of experiences with discrimination across time and to evaluate whether these experiences are associated with cognitive function among middle-aged Mexican-origin adults by addressing the following three goals: (1) evaluate the longitudinal trajectory of perceived discrimination across five waves of assessments over 12 years, and determine if there is significant inter-individual variance in the level and slope of the trajectory (2) identify distinct trajectory subgroups (e.g., stable high, stable low, varying); of perceived discrimination across waves; and (3) test whether individual differences in the slope of the trajectory, trajectory subgroup membership, and baseline, intermediary waves, and/or concurrent assessments of perceived discrimination are associated with cognitive function.

We hypothesized (Hypothesis 1a) that a higher perceived discrimination intercept will be associated with lower cognitive status, and that a positive (or less negative, if the average trajectory is declining) perceived discrimination slope will be associated with lower cognitive status (Hypothesis 1b). An exploratory component of this study was to identify distinct subgroups of perceived discrimination trajectories. Because experiences of discrimination are expected to be detrimental to cognitive function, we also hypothesized (Hypothesis 2) that less favorable trajectory classes (e.g., perceived discrimination is high and stable, increases over time, or is less negative) will be associated with lower cognitive status. The research hypotheses and data analysis plan were preregistered at the Open Science Framework at _____.

2. Methods

We used data from the California Families Project (<https://www.californiafamiliesproject.org/>), an ongoing longitudinal study of 674 Mexican-origin youth and their parents. We focused on data from the mothers and fathers who took part in the study ($N = 1,110$ at the first assessment). To recruit families, children were drawn at random from rosters of students from the Sacramento and Woodland, CA, school districts. To participate, the focal child had to be in the 5th grade, of Mexican origin, and living with their biological mother. Approximately 72.6% of the eligible families agreed to participate in the study, which was granted approval by the Institutional Review Board (Protocol # _____). The first assessment (Wave 1) occurred in 2006–2007 and follow-up assessments were conducted annually through Wave 10 and 2 years later for Wave 11. Participants were interviewed in their homes in Spanish or English, depending on their preference. Interviewers were virtually all bilingual and were of Mexican heritage. At Wave 1, 124 of the families were single-parent households (mothers only), and 549 of the families were two-parent households.

We used data from the mothers and fathers at Waves 1, 3, 5, 7, and 11, when measures of perceived ethnic discrimination were administered to them. On average, participants (63% women) were 38.18 years old ($SD = 6.10$, range = 26 to 62; median age = 37.66) at Wave 1. Sixty-four percent of participants had achieved less than a high school education by wave 8 (median education level was 9th grade). Median total household income was \$32,500 at Wave 1 (overall range of income = < \$5,000 to > \$95,000).

Of the original 1,110 participants, 87%, 90%, 86%, and 80% were retained at Waves 3, 5, 7, and 11, respectively. To investigate the potential impact of attrition, we compared individuals who did and did not participate in the Wave 11 assessment on study variables assessed at Wave 1. There were no significant differences in baseline discrimination, nativity, age, education, household income, and total IQ.

2.1. Measures

2.1.1. Perceived ethnic discrimination

At Waves 1, 3, 5, 7, and 11, participants completed a measure of ethnic discrimination that included items used in previous research on discrimination (Hughes and Dodge, 1997; James et al., 1994; University of Michigan's National Study of American Lives). The items used captured a wide range of different discrimination experiences and have been used successfully in other studies of perceived ethnic discrimination. Participants were asked to think about their experiences with people in their community and indicate how often they experienced various forms of discrimination (See Supplementary Fig. 1 for a complete list items used in this study). The measure included two subscales: a 10-item scale that assessed personal experiences with ethnic discrimination (e.g., “You are treated with less courtesy than other people because you are Mexican/Mexican-American”; “You are followed around in stores.”), and a 7-item scale that assessed general beliefs about how much society discriminates against Mexican-origin individuals (e.g., “There are fewer opportunities for good jobs or good pay for Mexican-Americans than for others”). Ratings were made on a 4-point Likert scale, ranging from 1 (*Almost never or never*) to 4 (*Almost always or always*). The general beliefs about discrimination scale was not administered at Wave 11 and thus we only used the personal discrimination scale in the present study (but see Supplementary Tables 1–4 for results with general beliefs about discrimination scale). We subtracted one from each response option to ensure interpretability of the zero points and calculated an average score across items with a possible range of 0–3.

2.1.2. Cognitive function

At Wave 11, participants completed cognitive tasks used in the Health and Retirement Study (HRS). Similar to HRS, the following six tasks were administered over the phone by trained researchers: immediate and delayed recall of 10 words, counting backwards from 20, number subtraction from 100 by 7, object recognition (scissors, cactus), and knowledge of current date (orientation). To create a composite measure of cognitive functioning, we summed the number of correct responses for all individuals with complete responses (possible range = 0–33).

2.1.3. Baseline IQ

At Wave 1, participants completed the Woodcock-Johnson III Test of Cognitive Abilities (Woodcock et al., 2001). Verbal IQ was based on a composite of the Picture Vocabulary, Synonyms, Antonyms, and Verbal Analogies scales. Fluid IQ was based on a composite of the Visual Matching scale and the number of minutes to complete the Visual Matching scale. We computed a total IQ score based on the mean of Verbal and Fluid IQ. We included this measure as a covariate in our predictive models to test for cognitive function relative to baseline IQ. This score was mean centered for analyses so that the zero point represented the average IQ score.

2.1.4. Nativity

Most participants (85.12%) were born in Mexico, and the remainder were born in the U.S. Nativity was coded 0 = U.S. and 1 = Mexico.

2.1.5. Language of interview

At Wave 11, 85.31% of participants were interviewed in Spanish, and the remainder were interviewed in English. This variable was coded 0 = English and 1 = Spanish.

2.1.6. Education

Educational attainment was collected at Wave 1 and again at Wave 8 considering that some parents were students during Wave 1. Median educational attainment was 9th grade in both waves and rank-order stability was 0.99. We used the updated Wave 8 educational attainment in these analyses.

2.2. Data Analyses

We used SAS version 9.4 (SAS Institute, 2013) for data preparation and descriptive statistics, and Mplus version 8.7 (Muthén & Muthén, 1998–2012) for longitudinal and predictive models. Models accounted for non-independence by specifying the family ID in the ‘Cluster’ statement, Type = Complex, and the maximum likelihood estimator with robust standard errors (MLR). Sample sizes are reported in Table 1. Of the 1,110 participants, 15 were missing data on all ethnic discrimination variables at all time points resulting in an analytic sample size of 1,095 for longitudinal trajectory analyses. Of the possible 883 observations at Wave 11, 30 were missing cognitive scores not at random due to the nature of the scoring in which only scores were computed for those with complete data in all tasks. The analytic sample size for cognition as the outcome was 853. The MLR estimator using Type = Complex applies a full information maximum likelihood solution that was used to handle missing data of our predictor variables (Lee and Shi, 2021; Schafer and Graham, 2002). The supplementary material provides a detailed description of the data analyses.

2.2.1. Univariate latent growth curve models

To determine the shape of the perceived discrimination trajectory, we compared four different univariate latent growth curve models: (1) a no growth model; (2) a linear growth model; (3) a quadratic model; (4) and a latent basis model, where the first and last time points of the slope are fixed (at ‘0’ and ‘11’, respectively) and the middle time points

Table 1
Descriptive statistics and intercorrelations among study variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Baseline Age	–										
2. Cognitive composite (W11)	–0.12**	–									
3. Discrimination (W1)	–0.03	–0.02	–								
4. Discrimination (W3)	0.00	–0.04	0.57***	–							
5. Discrimination (W5)	–0.01	–0.03	0.50***	0.53***	–						
6. Discrimination (W7)	0.00	0.00	0.48***	0.54***	0.54***	–					
7. Discrimination (W11)	0.03	–0.05	0.35***	0.35***	0.43***	0.42***	–				
8. Baseline IQ	–0.01	0.42***	0.00	0.04	0.01	0.04	0.06†	–			
9. Gender (0 = male; 1 = female)	–0.21***	0.08*	–0.09**	–0.14***	–0.12**	–0.07*	–0.07*	0.02	–		
10. Nativity (0 = U.S.; 1 = Mexico)	–0.02	–0.04	–0.11**	–0.17***	–0.13**	–0.15***	–0.15***	–0.38***	–0.08**	–	
11. Interview (0 = English; 1 = Spanish)	0.00	–0.01	–0.13**	–0.12**	–0.12**	–0.16**	–0.12**	–0.36***	–0.09*	0.80***	–
N	1,110	853	1,054	954	986	945	874	1,057	1,110	1,097	825
Mean (SD) / %	38.32 (6.10)	21.23 (3.74)	0.35 (0.39)	0.31 (0.34)	0.27 (0.34)	0.22 (0.29)	0.23 (0.37)	173.76 (16.17)	60.63%	85.87%	84.97%

Note. Means shown for continuous variables and percentages for categorical variables where category = 1. Values are rounded to two decimal points. Table shows results for all data not accounting for family clusters.

*** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$.

are freely estimated to the data. Path coefficients from the intercept to the repeated assessments were fixed to 1, and the intercept and slope were allowed to covary. Adequate model fit was assessed via the comparative fit index (CFI; Bentler, 1990), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA; Steiger and Lind, 1980), Bayesian information criterion (BIC), and Akaike's information criterion (AIC). Models with lower BIC and AIC values were considered better fits. CFI and TLI values greater than 0.95 (Hu and Bentler, 1999) and a RMSEA less than 0.10 (MacCallum et al., 1996) indicated adequate fit.

2.2.2. Growth mixture models

With significant variance in the slope parameter, we proceeded to a Growth Mixture Model to identify sub-groups with differing longitudinal change trajectory patterns in perceived discrimination. We followed the approach outlined by Ram and Grimm (2009) and Grimm et al. (2017). Appropriate number of classes was selected based on model fit. We used the BIC, AIC, and the sample size adjusted BIC whereby smaller values indicate better fit. The p -values for the Vuong-Lo-Mendell-Rubin (VLMR) and the adjusted Lo-Mendell-Rubin (LMR) likelihood ratio tests were considered in which values less than .05 were considered a significantly better fit compared to models with one less class. Higher entropy values (range: 0–1) indicated how distinguishable classes were from one another with a consideration criterion of 0.80 or higher. Once the appropriate number of classes was selected, we plotted the classes to describe them. The classification data was used to describe the classes based on demographics and to predict cognitive function based on class. A 1-tailed test of significance was reported for our model predicting Wave 11 cognition based on class membership given our a priori hypothesis; 2-tailed tests of significance were reported for remaining models.

3. Results

Table 1 presents intercorrelations for all study variables and descriptive statistics along the bottom two rows. Participants were 38.32 (6.10) years old on average at baseline, 60.63% were female and over 86% and 85% of them were born in Mexico or interviewed in Spanish, respectively. Participants' cognitive scores were above the midpoint of the 0 to 33 possible range with a mean of 21.31 (3.74). Average perceived discrimination scores were higher at Wave 1 than Wave 11, and test-retest correlations across waves showed that there was a weakening in rank-order stability as the time interval between waves in-

creased (Supplementary Table 5). Average perceived discrimination scores were low overall (means between 0.23 and 0.35 on a 0–3 scale); 25.91% of participants indicated that the discrimination events listed in the survey *almost never or never* happened to them at Wave 1, and 30.21%, 37.55%, 42.84%, 53.26% at Waves 3, 5, 7, and 11, respectively. Individual types of discrimination experienced are in Supplementary Table 6 and Supplementary Fig. 2. Overall, participants tended to report more frequent experiences with people acting as if they were not smart or people acting as if they were better than they are; feeling threatened or harassed was endorsed the least.

3.1. Univariate latent growth curve models results

Table 2 presents results from Latent Growth Curve models. The no Growth model was a poor fit; the Linear, Quadratic, and Latent Basis models all met RMSEA cutoff and CFI and TLI criteria. The Latent Basis model showed the lowest RMSEA, AIC, and BIC values and high CFI and TLI values. This model also showed a linear effect that plateaued between the last two waves, which reflected the average observed scores across waves (Table 1) and was selected as our final model. On average, there was a slight decrease in perceived discrimination across waves (slope = -0.012 , $SE = 0.001$, $p < .0001$; average change trajectory is plotted on Supplementary Fig. 3).

We evaluated whether baseline level (intercept) and change over time in perceived discrimination (slope) predicted cognitive scores accounting for baseline IQ. Neither the intercept ($B = -0.49$, $SE = 0.74$, $p = .53$) or slope ($B = -3.12$, $SE = 19.29$, $p = .87$) were significantly associated with cognitive function at Wave 11. These associations did not differ by gender, nativity, or language of interview.

3.2. Growth mixture models results

The intercept and slope parameters from the latent basis model had statistically significant variance (both $ps < .001$), indicating individual differences in the initial level and change over time in perceived discrimination. Consequently, we fit a series of Growth Mixture Models as described in the Data Analyses section. Table 3 shows the model fit indices for the one- and two-class models that were allowed to vary in average intercepts and slopes. The three-class model of this type had convergence problems and was thus not considered. Furthermore, models allowed to vary in their covariance and residual variance did not converge or included parameters that were out of bounds and were thus not considered. The 2-class model was selected as our final model as the

Table 2

Model comparisons for univariate latent growth curve models of perceived discrimination.

Slope Loadings	No Growth	Linear	Linear, Quadratic	Latent Basis ^a
B0	0	0	0, 0	0
B2	0	2	2, 4	4.787
B4	0	4	4, 16	7.985
B6	0	6	6, 36	11.057
B11	0	11	11, 121	11.000
Means				
Level	0	0.3202***	0.3529***	0.3508***
Slope	–	–0.0126***	–0.0344***	–0.0119***
Quadratic	–	–	0.0021***	–
Variances				
Level	0.1215***	0.0754***	0.0941***	0.0943***
Slope	–	0.0033**	0.0022*	0.0031**
Quadratic	–	–	0.0001	–
Covariances				
Level, Slope	–	–0.0033***	–0.0101***	–0.0039***
Level, Quadratic	–	–	0.0053**	–
Slope, Quadratic	–	–	–0.0013	–
Goodness-of-fit				
RMSEA	0.202	0.061	0.005	0.000
CFI	0.030	0.937	1.000	1.000
TLI	0.307	0.937	1.000	1.000
AIC	2745.421	1827.996	1770.376	1763.016
BIC	2775.412	1877.981	1840.355	1813.002

Note. Models account for clustering by family. RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker–Lewis index; AIC = Akaike's information criteria; BIC = Bayes information criteria.

*** $p < .001$; ** $p < .01$; * $p < .05$ † $p < .10$.

^a **Selected as final model.**

Table 3

Model fit information for the latent basis mixture growth models applied to perceived discrimination.

	One-class	Two-class ^a	Three-class*
Class Proportions	1.00	0.08/0.92	0.15/0.01/0.84
n	1095	87/1008	165/15/915
AIC	1886.112	1631.712	1482.961
BIC	1916.103	1676.698	1542.943
ABIC	1897.046	1648.112	1504.828
Entropy		0.916	0.894
VLMR p-value		0.04	–
LMR p-value		0.04	–

Note. Models account for clustering by family. n = class sample size.

^a **Best-fitting model; *Convergence issues were encountered.**

likelihood ratio tests showed that it was a significantly better fit than a one-class solution, and it had acceptable entropy (0.92) and class proportion classifications (8% and 92%).

Table 4 lists the parameter estimates for the selected 2-class model and shows that Class 1 (8% of sample) started off higher in perceived discrimination (Intercept = 1.24, SE = 0.13, $p < .0001$) and decreased slightly across waves (Slope = –0.06, SE = 0.01, $p < .0001$). Class 2 (92% of sample) started off low in discrimination

Table 4

Parameter estimates for the two-class model.

Parameter	Class 1 High Declining	Class 2 Stable Low
Intercept	1.244	0.271
Slope	–0.064	–0.007
Intercept Variance	0.027	0.027
Slope Variance	0.001	0.001
Covariance	–0.003	–0.003
Residual Variance	0.055	0.055

(Intercept = 0.27, SE = 0.02, $p < .0001$) and decreased minimally across waves (Slope = –0.01, SE = 0.001, $p < .0001$). Class 1 was labeled as the ‘High Declining’ class and Class 2 as the ‘Stable Low’ class. Fig. 1 portrays the predicted class trajectories.

There were no differences between the High Declining and Stable Low class in baseline age, household income, IQ, and educational attainment. However, women were more likely than men to be in the Stable Low class ($\chi^2(1) = 9.33$, $p < .01$), those born in Mexico were more likely to be in the Stable Low class than those born in the U.S. ($\chi^2(1) = 11.77$, $p < .001$), and those who completed the interview in Spanish were more likely to be in the Stable Low class than those who completed it in English ($\chi^2(1)^2 = 6.47$, $p < .05$).

We tested whether class membership was associated with cognitive scores at Wave 11. Those in the Stable Low class had slightly higher cognitive scores ($M = 21.34$, $SD = 3.70$) compared to those in the High Declining class ($M = 20.58$, $SD = 4.17$), $d = 0.20$. Predictive models showed that the Stable Low class had better performance than the High Declining class after accounting for baseline IQ ($B = 0.83$, $SE = 0.46$, $p = .04$); this was no longer significant after accounting for level of education ($B = 0.76$, $SE = 0.46$, $p = .05$). This association was not moderated by age ($B = 0.04$, $SE = 0.07$, $p = .91$; Supplementary Table 9). We also found that this association did not further differ by gender, nativity (born in the U.S. vs Mexico), and language of interview (Supplementary Table 7).

3.3. Associations between wave-specific discrimination and cognition

We evaluated whether earlier and concurrent experiences of discrimination were associated with cognitive function via five separate regression models in which Wave 1 (baseline), 3, 5, 7, and 11 (concurrent) discrimination predicted cognitive function, controlling for baseline IQ. Neither baseline nor intermediary waves were significantly associated with cognition (B s range = –0.18 to –0.54). Baseline discrimination was also not significantly associated with baseline IQ. However, higher perceived discrimination scores at the last wave (Wave 11) significantly predicted lower cognitive performance ($B = -0.81$, $SE = 0.35$, $p = .02$). This effect remained after further accounting for level of education ($B = -0.80$, $SE = 0.35$, $p = .02$) and was not moderated by age ($B = 0.05$, $SE = 0.06$, $p = .41$; see Supplementary Table 10). The associations did not significantly differ by gender, nativity, or language of interview (Supplementary Table 8). Although this association did not significantly differ by class membership, the High Declining group did have higher Wave 11 discrimination compared to the Stable Low group (Welch's $t(62.67) = -7.82$, $p < .0001$; see Table 5).

4. Discussion

Building on prior literature, the present study addressed two key questions: (1) How does perceived discrimination change across middle adulthood? (2) How are discrimination and the trajectory of discrimination associated with cognition? We found that, on average, perceptions of ethnic discrimination decreased over time and that individual differences in this average change trajectory revealed two change classes, a Stable Low and a High Declining class. The Stable Low class had higher cognitive scores compared to the High Declining class. There was also a concurrent association between discrimination at the last wave and cognition, whereas perceived ethnic discrimination at the first and intermediary assessment waves was not prospectively associated with cognitive function.

About 74% of participants indicated that they experienced discrimination *Sometimes* or more often in the first assessment wave and this proportion decreased to 47% by the last wave in this study. In comparison, United States' representative data of Latinxs' experiences with discrimination indicate that a third or more of Latinxs 18 years or older had personally experienced discrimination (Discrimination in America,

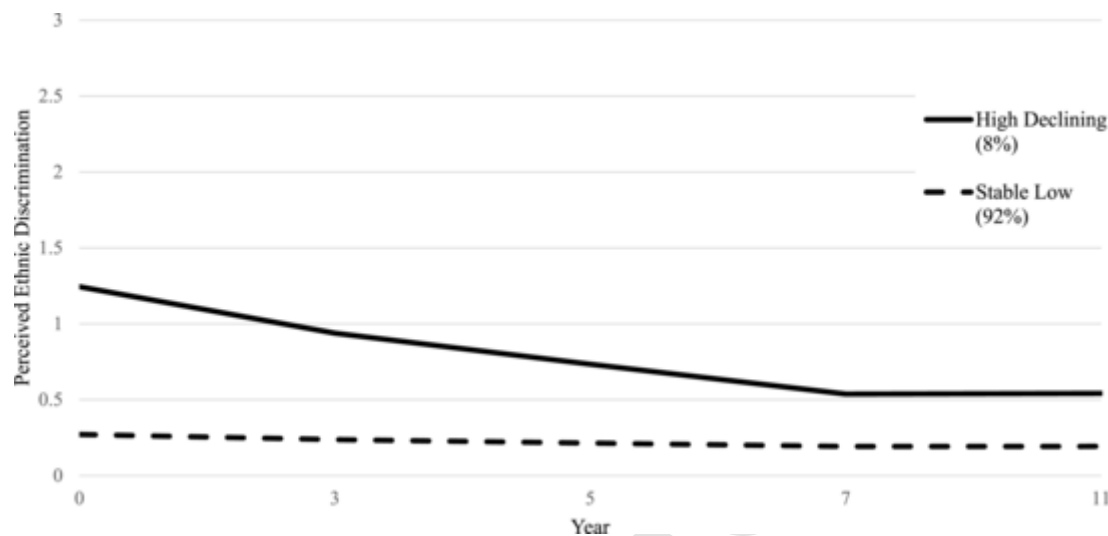


Fig. 1. Predicted class trajectories from the two-class growth mixture model.

Table 5
Descriptive statistics for selected classes.

	Stable Low	High Declining
	Mean (SD)/n (row %)	Mean (SD)/n (row %)
Baseline Age	38.32 (6.08)	38.17 (6.26)
Cognitive Composite Score (W11)	21.34 (3.70)	20.58 (4.17)
Baseline IQ	173.68 (16.10)	175.36 (16.99)
Gender		
Male	377 (88.92%)	47 (11.08%)
Female	631 (94.04%)	40 (5.96%)
Nativity		
U.S.	132 (85.16%)	23 (14.84%)
Mexico	865 (93.21%)	63 (6.79%)
Interview		
English	108 (87.10%)	16 (12.90%)
Spanish	656 (93.58%)	45 (6.42%)
Ethnic Discrimination (W11)	0.20 (0.31)	0.56 (0.61)

Note. Means and standard deviations (SD) shown for continuous variables and frequency.

(n) and row percentages (%) for categorical variables. W11 = Wave 11.

2017). We found that those who were interviewed in Spanish or born in Mexico were more likely to be in the Stable Low perceived discrimination class compared to those who were interviewed in English or born in the U.S. These findings are consistent with U.S. data indicating that non-immigrant Latinxs report greater experiences with discrimination compared to immigrants (Discrimination in America, 2017). Our results also corroborate previous research showing that greater levels of acculturation (often measured via language of interview) tend to be associated with greater experiences with discrimination (Finch et al., 2000; Pérez et al., 2008).

To our knowledge, this is the first study to evaluate the longitudinal trajectory of perceived ethnic discrimination across middle adulthood in U.S. Latinx adults, with prior work in the Latinx population focusing on earlier stages of the lifespan (childhood and adolescence). In adults generally, research using the Midlife in the United States Study (MIDUS; baseline mean age = 47; Fuller-Rowell et al., 2018) and the Study of Women Across the Nation (SWAN; baseline mean age = 46; Upchurch et al., 2015) found that perceived discrimination showed no significant change across two waves (time interval between assessments = 9 years for MIDUS, and 3 years for SWAN). In contrast, our results show that there is an average gradual decrease in perceived ethnic discrimination in Mexican-origin adults across twelve years during midlife (baseline mean age = 38). This decline may reflect motiva-

tional shifts to focus less on negative experiences (e.g., Carstensen et al., 1999) and tighter and emotionally close social networks established by midlife (Antonucci et al., 2014) that may decrease the likelihood of discriminatory interactions. We also asked participants about their experiences with discrimination due to their ethnicity, but attributions of discrimination may shift to other characteristics, such as age, over time (Kessler et al., 1999).

Discrimination across middle adulthood was associated with cognition. There was evidence that those in the Stable Low class had better cognitive function than their counterparts in the High Declining class. This finding shows that the experience of ethnic discrimination at some point during adulthood has a detrimental impact on cognitive functioning. This may be indicative of cumulative effects such that any experience of discrimination after the first, although rarer, is an additional “hit” of stress that builds on the previous one creating psychological and physiological wear and tear that results in reduced cognitive function (Geronimus, 1992; Lupien et al., 2009). We did not find moderation of class (nor Wave 11 discrimination) by age, which indicates that the negative association between discrimination and cognition was similar relatively earlier and relatively later in middle adulthood. This could be due, in part, to the close distribution of ages with 90% of participants between 30 and 50 years of age. The effect between perceived discrimination classes and cognition was not significant after accounting for educational attainment, which suggests that education may account for part of this association. Experiences with discrimination may limit educational opportunities that subsequently predict lower cognitive function in adulthood (e.g., Clouston et al., 2020). This question is worthy of a more detailed exploration in future studies.

Perceived discrimination was concurrently associated with lower cognitive function at that last wave, whereas discrimination during earlier waves and at baseline did not prospectively predict cognitive function at the 12-year mark. This result suggests that there may also be acute effects of discrimination on cognitive function. A potential mechanism for this link includes increases in intrusive, ruminative thoughts about the stressful, discriminatory experiences that disrupt attentional processing and thus performance on cognitive tasks (e.g., Stawski et al., 2006, 2009). The concurrent associations between discrimination and cognitive function did not vary significantly for men and women, for individuals born in the U.S. versus Mexico, for individuals who were interviewed in English versus Spanish or by age; this association also remained after accounting for education. The lack of association between earlier discrimination and cognition may indicate that there are intermediary protective factors against the detrimental effects of perceived ethnic discrimination—a question beyond the scope of this paper but

worth pursuing in future studies. It is worth noting that the concurrent association between baseline discrimination and baseline IQ was not significant. Although this composite IQ score is a marker of cognitive function and was significantly correlated with our total composite score ($r = 0.42$, $p < .001$), it does not measure other relevant domains included in our composite cognitive score at the last wave (e.g., episodic memory). Notwithstanding these measurement differences, the fact that the concurrent association between perceived discrimination and cognitive function held at the last wave but not at the initial wave also raises the possibility that the association becomes stronger as the participants grow older.

Consistent with this interpretation, recent cross-sectional research has shown that discrimination (in conjunction with social stressors related to one's network and isolation) is associated with baseline level of cognitive function in a sample of older Latinxs (mean age = 67.9 years; Lamar et al., 2021). Our results extend this work by establishing a similar association among middle-aged individuals, specifically of Mexican origin. However, Zahodne et al. (2017a, 2017b) did not find an association between perceived discrimination and episodic memory in Latinx participants (mean age = 73 years), although, as the authors noted, their measure of discrimination was not specific to being Latinx. The perceived ethnic discrimination measure used in the present study specifically asked participants to report whether they experienced discrimination "... because you are Mexican/Mexican-American", thus highlighting the need to examine the attributions of experiences of discrimination in relation to cognitive health outcomes. We primarily present results with personal experiences of discrimination, (e.g., "People assume that you are not as smart or capable as others because you are Mexican/Mexican-American"). General beliefs about discrimination (e.g., "There are fewer opportunities for good jobs or good pay for Mexicans/Mexican-Americans than for others") were also measured in most waves except the last wave, and we also found an overall pattern whereby general beliefs about discrimination decreased, but there were no significant associations with cognition (see Supplementary Tables 1–4). This suggests that personal experiences with discrimination may be more relevant for cognition, although more work in this area is needed.

4.1. Limitations and future directions

This study has some limitations worth considering. We did not have longitudinal assessments of cognitive function and were only able to examine cognitive function at the last assessment wave, and in the first wave by proxy with total IQ. We were therefore not able to evaluate if changes over time in perceived ethnic discrimination covaried with changes over time in cognitive function (e.g., using bivariate growth curve models). Our study participants lived in California and thus our study results can only be applied to adults in California who are of Mexican origin. Although this is also a strength given the vast heterogeneity within the Latinx community, allowing us to pinpoint specific mechanisms of cognitive health within this subpopulation, future studies evaluating these processes among Latinx individuals from other countries of origin and geographical locations are needed. By design, this study is also only composed of parents precluding our ability to test associations among Mexican-origin adults who are not parents. Nonetheless, 90% of the Latinx U.S. population had at least one child in 2015 (Pew Research Center, 2015) suggesting that we are not overly restricting the representativeness of our study. Nonetheless, it is likely that having school-aged children and interacting with the school system may expose participants of this study to more discrimination by proxy of their children. At the same time, having connections to the school system might increase social capital among parents that may buffer the effects of stress from discrimination. Future research examining experiences with discrimination among parents and non-parents across the lifespan is needed to further evaluate these processes. We did leverage available

data on the number of children in each household and found that the associations in his study remained after accounting for this variable (see Supplementary Tables 9 and 10). Certainly, future research examining the role of children (including the number and their age) on experiences of discrimination and resulting cognitive health consequences is worthy of investigation. Further, our 12 years of assessments, although substantial, did not cover all of adulthood; future investigation with longer follow-ups are needed to discern the pattern of associations into older adulthood when cognitive decline may become more apparent. Lastly, future investigations that evaluate the mediating psychosocial (e.g., loneliness, anxiety) and physiological (e.g., physical health, biomarkers of stress and health) pathways in the associations observed in this study are also needed to identify the process through which these experiences are associated with cognitive function.

5. Conclusions

With the growing ethnic diversity in the aging population, and the disproportionate risks for cognitive impairment among Hispanic/Latinx adults, it is imperative to identify risk factors for cognitive impairment in this population. This study is among the first to identify unique change trajectory classes of perceived ethnic discrimination in adults of Mexican origin. We found that those who started off reporting high levels of discrimination and declined across a 12-year period (High Declining group) had poorer cognitive function than the Stable Low group who reported lower levels of discrimination throughout the 12-year period. We also demonstrated a negative concurrent association between discrimination and cognitive function at the last assessment wave. The results demonstrate the need for more research to fully understand how and when this ethnically relevant social stressor is associated with cognitive function.

Author statement

Elizabeth Muñoz: Conceptualization, Writing – original draft, Methodology, Formal analysis. **Richard W. Robins:** Writing – review & editing, Funding acquisition, Data curation, Resources. **Angelina R. Sutin:** Writing – review & editing, Funding acquisition, Resources, Supervision.

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Declaration of interest

None.

Data availability

Data will be made available on request.

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Contact the corresponding author for data used in this manuscript. The conducted research was preregistered at the Open Science Framework at: <https://osf.io/xkujf>. For a complete list of California Families Project publications, see: <https://www.californiafamiliesproject.org/publications.html>.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2022.115296>.

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