Hispanic/Latino Acculturation Profiles and Telomere Length: Latent Class Analysis on a Nationally Representative Sample

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Background: Acculturation profiles and their impact on telomere length among foreign-born Hispanics/Latinos living in the United States (US) are relatively unknown. The limited research available has linked acculturation with shortened telomere length.

Objectives: To identify acculturation profiles among a US representative sample of Hispanics/Latinos and to then examine telomere length differences between profiles.

Methods: We conducted a latent class analysis among a non-institutionalized US-representative sample of Hispanics/Latinos using the 1999–2002 National Health and Nutrition Examination Survey (N = 2,292). The latent variable of acculturation was assessed by length of time in the US and language used as a child, read and spoken, usually spoken at home, used to think, and used with friends (i.e., Spanish and/or English). Telomere length assessed from leukocytes was used as the distal continuous outcome.

Results: We identified five profiles: (1) low acculturated [33.2% of sample]; (2) partially integrated [18.6% of sample]; (3) integrated [19.4% of sample]; (4) partially assimilated [15.1% of sample]; and (5) assimilated [13.7% of sample]. Acculturation profiles revealed nuanced differences in conditional probabilities with language use despite the length of time spent in the US. While telomere length did vary, there were no significant differences between profiles.

Conclusion: Profiles identified revealed that possible life-course and generational effects may be at play in the partially assimilated and assimilated profiles. Our findings expand public health research using complex survey data to identify and assess the dynamic relationship of acculturation profiles and health biomarkers, while being among the first to examine this context using a person-centered approach.

Keywords: acculturation, telomere length (TL), latent class analysis (LCAs), Hispanic (demographic), complex survey data, Latino (Hispanic)
INTRODUCTION

Acculturation is a dynamic process by which individuals, often immigrants, enter into a new host culture (1, 2) that has both indirect and direct effects on behavior and biology (3, 4). A particular biological marker or biomarker of interest are telomeres—caps of tandem repeat nucleotide sequences at the end of chromosomes that help protect cellular information during replication. The caps diminish as cells divide. As such, telomere length has been used as a biomarker of cellular aging or senescence (5–7). This diminishment has been used to predict accelerated senescence and senescence-associated diseases that increase morbidity and mortality in specific population profiles (8–13), and may be affected by the acculturative process (14).

Senescence-associated diseases include cardiometabolic disorders (e.g., type II diabetes), neurodegeneration (e.g., Alzheimer’s and Parkinson’s disease), and some types of cancers (15–17). Moreover, the common factors associated with telomere shortening in both animal and human studies are lifestyle and demographic factors including physical activity, diet, and nicotine use, as well as socioeconomic status have been linked to telomere length (7, 11, 18). A possible mechanistic pathway is that stress causes an oxidative response that affects humans at a cellular level, whereby cells dividing more frequently shorten telomeres and cause apoptosis at higher rates (6, 15). The stressful process of acculturation has been found to have a shortening effect on telomere length (14), and therefore acculturation may be associated with shortened telomeres. Other environmental factors and exposures that have been associated with telomere length may be directly and indirectly related to acculturation; these include biological ancestry categorized by race/ethnicity, poverty, and the built environment of—and environmental exposures from—neighborhoods (19, 20).

Acculturation has been associated with negative health consequences among Hispanics/Latinos (21–24) and other underrepresented groups such as African Americans (25–27). Acculturation may then further exacerbate health disparities in already-vulnerable groups. Among Hispanics/Latinos acculturation has been historically measured by language use. One longstanding validated linguistic acculturation measure is the Short Acculturation Scale for Hispanics (SASH), originally developed by Marin and colleagues (28) and recently validated by Hamilton and colleagues (29). While linguistic acculturation is used as a powerful measure to ascertain an individual’s strategy to separate, integrate, marginalize, or assimilate into a new culture in the United States (US) (2, 30), it is unknown how the process is directly related to health biomarkers like telomere length.

Our study builds upon the limited research on acculturation and telomere length, especially among US Hispanics/Latinos. We used latent class analysis (LCA) to, first, identify acculturation profiles among US Hispanics/Latinos based on a nationally representative sample. Our second objective was to examine if differences in telomere length among identified Hispanic/Latino acculturation profiles existed. We proposed that at least three heterogenous profiles of acculturation would be identified. We hypothesized that telomere length would be significantly different between the identified acculturation profiles. We based our hypothesis on a study by Ruiz and colleagues (14) focused on a cohort of Mexican-American pregnant mothers’ telomere length as it related to acculturation, discrimination, depression, and their levels of psychosocial stress. Ruiz and colleagues (14) reported a strong relationship between shortened telomere length and mothers’ latent variables of negative affect from stressful experiences and acculturation strategies oriented toward US host culture, especially when compared to newly immigrated mothers.

MATERIALS AND METHODS

LCA refers to a person-centered technique used to identify unobservable, or latent, profiles within a population (31, 32). We conducted LCA using the National Health and Nutrition Examination Survey (NHANES) US Hispanic/Latino adult (18 years old and older) sample from the 1999–2002 cycles. Hispanic/Latino was operationalized based on NHANES defined race/ethnicity variables that self-identified as Mexican American and Hispanic. The 1999–2002 NHANES cycles allowed us to assess the impact of multiple acculturation factors on mean leukocyte telomere length. The 1999–2002 sample includes useable data from 2,292 Hispanic/Latino participants with acculturation questionnaire data and telomere length data. The Institutional Review Board assessed the research protocol, and as no human participants were involved in this study no approval was necessary. The secondary data analyzed from the 1999–2002 NHANES cycle are publicly available from the Centers for Disease Control and Prevention—National Center for Health Statistics database (https://wwwn.cdc.gov/nchs/nhanes/Default.aspx). A detailed description of the sampling methods and study procedures is available elsewhere (33). Sampling weights were included in all analyses to adjust for survey non-response and sample selection probabilities for the 1999–2002 cycles. Primary sampling units and stratum variables were included to account for the NHANES complex sampling design. All data and analytical files are available upon reasonable request.

Measures

Acculturation

We developed our acculturation latent variable from length of time in the US and language used among Hispanics/Latinos, i.e., Mexican American and other Hispanics. Other Hispanics, as reported in the NHANES, were participants that identified as Hispanic not of Mexican descent. Length of time was split into four categories: (1) <1 year; (2) 1 – <5 years; (3) 5 – <10 years; and (4) 10 years or more (34–36). Language specific questions were modeled after the SASH, which was originally developed by Marin and colleagues (28). The NHANES acculturation questionnaire gauged language used in the context of: (1) as a child; (2) for reading and speaking; (3) at home; (4) to think; and (5) with friends. Response options for all language used questions were: (1) only Spanish; (2) more Spanish than English; (3) both equally; (4) more English than Spanish; and (5) only English.

Telomere Length

NHANES collected blood from participants to conduct biomarker and other biological analyses. Telomere data were
only publicly available during the 1999–2002 NHANES cycles. Telomere length was assessed from leukocyte assays performed using a quantitative polymerase chain reaction method to measure length relative to standard reference DNA or T/S ratio. See Needham and colleagues (11) for greater detail on lab assay techniques.

Sociodemographic and Lifestyle Descriptive Variables
Variables such as gender/sex (i.e., male and female), US citizenship (i.e., no or yes), less than a high school education (i.e., no or yes), smoked at least 100 cigarettes in lifetime (i.e., ever-smoker), and moderate physical activity over the past 30 days (i.e., no or yes) were assessed as descriptives for our sample due to their associations with telomere length (14, 19). Hispanic/Latino composition (i.e., Mexican American or other Hispanic) and citizen of the US (i.e., no or yes) were also assessed.

Latent Class Analysis
The latent or unobserved variable of acculturation was based on six observed acculturation variables and the distal continuous outcome of telomere length (see Figure 1). We conducted our LCA with Mplus 8.6 (Muthén & Muthén) using a robust maximum likelihood estimator and automatic BCH approach. The automatic BCH method—a modification of the approach developed by Bolck, Croon, and Hagenaars (37)—was used to estimate mean telomere length within each profile and compare differences between profiles.

We used a model comparison approach to determine the number of classes. A one-class model up to a seven-class model was subsequently calculated. The one-class model was calculated to assess fit indices and compare with subsequent models. To assess model fit and reliability, we used Bayesian information criterion (BIC), sample-size-adjusted-BIC (ssaBIC), and entropy (i.e., acceptable quality of classification). We evaluated all models based on fit indices and their practical and theoretical considerations.

RESULTS
The weighted sample was on average ~40 years of age and equal across gender/sex, with male participants accounting for 49.9 and females 50.1%. The Hispanic/Latino sample was also almost equally weighted between Mexican Americans (50.7%) and other Hispanics (49.3%). Most of the sample were citizens of the US (61.6%) and had more than a High School degree or GED (54.9%), with a mean family poverty income ratio of 2.04. Much of the weighted sample had not smoked more than 100 cigarettes in their lifetime (56.7%), nor engaged in at least moderate physical activity over the past 30 days (64.4%). The Hispanic/Latino mean telomere length was 1.08 T/S ratio. For more details about participant characteristics (see Table 1).

Table 2 has the Hispanic/Latino weighted sample acculturation profile. Most participants lived in the US for 10 years or more (60.7%). The largest proportions of the sample used Spanish only as a child (40.2%), to read and speak (29.7%), at home (42.9%), to think (42.0%), and with friends (35.7%).

Latent Class Analysis of Acculturation
The five-class model with low BIC, ssaBIC, and high entropy of 0.891, as well as the most practical and theoretical considerations, was favored (see Table 3).

Class 1, or the low acculturated profile (33.2% of sample), with mean telomere length of 1.043, was composed of Hispanics/Latinos that had the highest conditional probabilities of being in the US <10 years. Class 1 had the highest conditional probabilities of using Spanish only during childhood (100%), to read and speak (88.0%), at home (99.6%), to think (99.8%), and with friends (96.4%).

Class 2, or the partially integrated profile (18.6% of sample), with mean telomere length of 1.102 had a high conditional probability of being in the US more than 10 years (65.5%). Class 2 had the highest conditional probabilities of using more Spanish than English (but not using Spanish exclusively) to read and speak (75.8%), at
home (38.3%), to think (34.5%), and with friends (41.5%). The vast majority (86.1%) of this class used Spanish only as a child.

Class 3, or the integrated profile (19.4% of sample), with mean telomere length of 1.084 had a high conditional probability of being in the US more than 10 years (86.1%). Class 3 had the highest probabilities of using Spanish and English equally to speak as a child (28.3%), to read and speak (74.6%), at home (58.7%), to think (64.4%), and with friends (74.0%).

Class 4, or the partially assimilated (15.2% of sample), with mean telomere length of 1.108 had the highest conditional probability of being in the US more than 10 years (93.2%). Class 4 had the highest conditional probabilities of using more English than Spanish to speak as a child (35.5%), to read and speak (81.1%), at home (49.4%), to think (37.5%), and with friends (47.8%).

Class 5, or the assimilated (13.7% of sample), with mean telomere length of 1.101 had the second-highest conditional probability of being in the US more than 10 years (83.6%). Class 5 had the highest conditional probabilities of using only English to speak as a child (68.9%), to read and speak (68.9%), at home (100%), to think (99.9%), and with friends (97.4%). See Table 4 for full detail of the latent class conditional probabilities.

### TABLE 1 | Descriptive statistics of weighted participant sample (N = 2,292).

| Sex/gender          | Frequency (weighted %) | Weighted frequency (SE) |
|---------------------|------------------------|-------------------------|
| Male                | 1,092 (49.9)           | 11,518,928 (1,110,137)  |
| Female              | 1,200 (50.1)           | 11,585,213 (1,273,746)  |
| Hispanics/Latinos   |                        |                         |
| Mexican Americans   | 1,875 (50.7)           | 11,704,451 (1,276,076)  |
| Other Hispanics     | 417 (49.3)             | 11,399,691 (2,134,279)  |
| Citizen of the US (n = 2,277) |            |                         |
| No                  | 906 (38.4)             | 8,816,781 (1,275,864)   |
| Yes                 | 1,371 (61.6)           | 14,164,806 (1,379,033)  |
| Less than high school education (n = 2,287) |       |                         |
| No                  | 933 (54.9)             | 12,651,015 (1,296,845)  |
| Yes                 | 1,092 (45.1)           | 10,373,192 (1,133,168)  |
| Ever-smoker (n = 2,284) |                     |                         |
| No                  | 1,302 (56.7)           | 13,058,383 (1,133,168)  |
| Yes                 | 982 (43.3)             | 9,986,520 (1,055,595)   |
| Moderate physical activity over past 30 days (n = 2,289) |           |                         |
| No                  | 1,152 (64.4)           | 14,876,583 (1,646,121)  |
| Yes                 | 737 (35.6)             | 8,207,544 (821,444)     |

### TABLE 2 | Acculturation measure responses of weighted participant sample (N = 2,292).

| Language used as child | Frequency (weighted %) | Weighted frequency (SE) |
|------------------------|------------------------|-------------------------|
| Spanish only           | 1,477 (60.2)           | 13,649,132 (1,747,330)  |
| More Spanish than English | 236 (10.4)            | 2,364,162 (277,464)     |
| Both equally           | 207 (10.7)             | 2,412,563 (293,549)     |
| More English than Spanish | 178 (8.1)             | 1,834,010 (251,671)     |
| English only           | 175 (10.6)             | 2,403,690 (296,529)     |
| Language used to read and speak |        |                         |
| Spanish only           | 797 (29.7)             | 6,732,782 (1,005,467)   |
| More Spanish than English | 456 (20.0)            | 4,529,867 (666,345)     |
| Both equally           | 413 (20.2)             | 4,580,644 (449,177)     |
| More English than Spanish | 413 (19.9)            | 4,508,553 (526,949)     |
| English only           | 196 (10.2)             | 2,317,946 (296,526)     |
| Language used at home  |                        |                         |
| Spanish only           | 1,082 (42.9)           | 9,700,915 (1,588,146)   |
| More Spanish than English | 227 (9.7)             | 2,196,253 (305,020)     |
| Both equally           | 304 (15.1)             | 3,419,966 (407,964)     |
| More English than Spanish | 271 (12.1)            | 2,736,351 (335,478)     |
| English only           | 390 (17.0)             | 4,582,019 (406,487)     |
| Language used to think |                        |                         |
| Spanish only           | 1,046 (42.0)           | 9,446,896 (1,455,867)   |
| More Spanish than English | 215 (8.8)             | 1,985,948 (23,815)      |
| Both equally           | 328 (15.8)             | 3,561,690 (319,875)     |
| More English than Spanish | 210 (9.2)             | 2,057,699 (287,652)     |
| English only           | 466 (24.2)             | 5,449,538 (496,264)     |
| Language used with friends |                   |                         |
| Spanish only           | 965 (35.7)             | 8,076,402 (1,230,584)   |
| More Spanish than English | 244 (9.7)             | 2,203,670 (401,562)     |
| Both equally           | 411 (15.0)             | 4,762,837 (490,468)     |
| More English than Spanish | 248 (12.7)            | 2,867,081 (343,425)     |
| English only           | 406 (20.9)             | 4,726,388 (414,047)     |

**PIR, poverty income ratio; SE, Standard Error.**

Mean Telomere Length Across Latent Classes

Telomere length by profiles were compared. The automatic BCH approach revealed that the equality test of means across classes for the overall differences was not significant (\(\chi^2 = 4.54, \text{df} = 4, p = 0.34\)). See Appendix for Supplementary Table 1 for between class mean comparisons.

### DISCUSSION

Our study using a nationally representative sample identified five profiles of Hispanic/Latino linguistic acculturation and their respective telomere length. In using the five SASH items in conjunction with time spent in the US we were able to...
create more dynamic profiles based on the acculturative process. The acculturative process involves language and behavioral norm acquisition from prolonged contact with the host culture (2, 30). US Hispanics/Latinos have been reported to have various acculturation strategies that include marginalization (i.e., rejection of both native and host culture), segregation (i.e., non-integration into the host culture), enculturation, integration, or assimilation (24, 38–40). Enculturation is often operationalized as reintegration or relearning of an individual’s native culture (24). Integration is the process where an individual adopts aspects of the host culture without the loss of their native culture (1). Assimilation is the process where the individual replaces aspects of the native culture with those adopted from the host culture (1). The process of assimilation in the acculturative process can be a source of high psychosocial stress due to feelings of otherness and discrimination (34, 40, 41), as well as the lifestyles changes that lead to a loss of social support and unhealthy behaviors (23, 42, 43). The psychosocial effects are prominent in subsequent generations, as protective health behaviors and support structures from the native culture diminish. Moreover, Hispanic/Latino groups are reported to experience worse health outcomes as they become more similar to their US counterparts (24).

Language serves as a primary factor to integration into a new host culture (28). For instance, in reviewing the low acculturated (Class 1) profile of US Hispanics/Latinos that almost exclusively used Spanish regardless of time spent living in the US, two patterns emerged in this profile that will require further examination. First, the low acculturated profile had an approximate conditional probability of 34% to be in the US <1 year and between 1 and <5 years, which would explain the Spanish only linguistic acculturation. Newly arrived immigrant groups will learn the host country’s culture and language, or that is the expectation of the host country for the newly immigrated (1, 2, 44). Second, the highest conditional probability of time spent in the US, was 47% on 10 years or more. The high conditional probability of being in the US for a decade or longer in the US acculturated class to have lived in the US 10 or more years (65.5% conditional probability). By contrast, the partially integrated (Class 2) spoke more Spanish than English and were more likely than the low acculturated class to have lived in the US 10 or more years (65.5% conditional probability). The integrated (Class 3) was comprised of Hispanics/Latinos living in the US 10 or more years that used English and Spanish equally, at home, to think, to read and speak, and with friends. The integrated profiles may indicate biculturalism or adaptive profiles. While the integrated profiles are often adaptive, there are some mental and physiological health concerns. Hispanics/Latinos in this adaptive bicultural process adopt customs and language norms that will benefit their integration into the larger US culture (24, 38, 40). Issues concerning identity are at the crux of this process as the degree to which Hispanics/Latinos have a choice to enculturate, integrate, or assimilate is unknown as are the health consequences.

Most individuals (57.8%) in the integrated class used at least some English during childhood—although a plurality (42.2%) of them solely spoke Spanish during this period of their lives. More than two-fifths (42.2%) of people in this class used Spanish

| Model          | BIC     | ssaBIC  | Entropy |
|----------------|---------|---------|---------|
| One-class solution | 35576.764 | 35503.688 | -       |
| Two-class solution  | 28410.596 | 28261.268 | 0.944   |
| Three-class solution | 26075.609 | 25850.030 | 0.929   |
| Four-class solution  | 24801.132 | 24346.796 | 0.898   |
| Five-class solution  | 24801.132 | 24346.796 | 0.898   |
| Six-class solution   | 24801.132 | 24346.796 | 0.898   |
| Seven-class solution  | 24801.132 | 24346.796 | 0.898   |

**TABLE 3 | Latent class analysis fit criteria of acculturation and telomere length models.**

BIC, Bayesian information criteria; ssaBIC, sample size adjusted BIC.
### TABLE 4 | Conditional probabilities of 5-class solution from latent class model (N = 2,282).

| Class 1: Low acculturated | Class 2: Partially integrated | Class 3: Integrated | Class 4: Partially assimilated | Class 5: Assimilated |
|---------------------------|-------------------------------|---------------------|-------------------------------|---------------------|
| 33.2% (n = 757)           | 18.6% (n = 424)               | 19.4% (n = 442)     | 15.1% (n = 346)               | 13.7% (n = 312)     |

**Length of time in the US**
- Less than 1 yr in US: 0.113, 0.081, 0.000, 0.000, 0.000
- More than 1 yr, less than 5 yrs: 0.231, 0.112, 0.051, 0.068, 0.164
- More than 5 yrs, less than 10 yrs: 0.182, 0.152, 0.088, 0.000, 0.000
- 10 yrs or more years: 0.473, 0.655, 0.861, 0.932, 0.836

**Language used as child**
- Spanish only: 1.000, 0.861, 0.422, 0.161, 0.017
- More Spanish than English: 0.000, 0.115, 0.231, 0.196, 0.053
- Both equally: 0.000, 0.023, 0.283, 0.221, 0.103
- More English than Spanish: 0.000, 0.000, 0.024, 0.355, 0.138
- English only: 0.000, 0.000, 0.040, 0.067, 0.689

**Language used to read and speak**
- Spanish only: 0.880, 0.038, 0.006, 0.000, 0.000
- More Spanish than English: 0.120, 0.758, 0.053, 0.019, 0.000
- Both equally: 0.000, 0.195, 0.746, 0.133, 0.037
- More English than Spanish: 0.000, 0.010, 0.149, 0.811, 0.275
- English only: 0.000, 0.000, 0.046, 0.037, 0.689

**Language used at home**
- Spanish only: 0.996, 0.416, 0.065, 0.050, 0.000
- More Spanish than English: 0.003, 0.383, 0.096, 0.023, 0.000
- Both equally: 0.001, 0.082, 0.587, 0.160, 0.000
- More English than Spanish: 0.000, 0.028, 0.184, 0.494, 0.000
- English only: 0.000, 0.000, 0.046, 0.273, 1.000

**Language used to think**
- Spanish only: 0.988, 0.425, 0.054, 0.006, 0.000
- More Spanish than English: 0.007, 0.345, 0.074, 0.032, 0.000
- Both equally: 0.005, 0.185, 0.644, 0.028, 0.000
- More English than Spanish: 0.000, 0.041, 0.116, 0.375, 0.001
- English only: 0.000, 0.004, 0.112, 0.559, 0.999

**Language used with friends**
- Spanish only: 0.964, 0.189, 0.018, 0.000, 0.000
- More Spanish than English: 0.022, 0.415, 0.029, 0.021, 0.003
- Both equally: 0.011, 0.260, 0.740, 0.122, 0.003
- More English than Spanish: 0.003, 0.088, 0.145, 0.478, 0.020
- English only: 0.000, 0.047, 0.068, 0.380, 0.974

**Telomere length**
- Mean T/S ratio (SE): 1.043 (.033), 1.102 (.037), 1.084 (.034), 1.108 (.033), 1.101 (.031)

SE, Standard Error.

Only as a child. The integrated class indicated possible language use change over time. Interestingly, even though the conditional probability of using more English than Spanish to think was highest for this class, a majority of people (55.9%) in the partially assimilated (Class 4) reported using English only to think. The partially assimilated (Class 4) were those with the highest likelihood of living in the US 10 or more years and using more English than Spanish but not exclusively English to read and speak, at home, and with friends. The partially assimilated class illustrated the importance of social context for language use, as many individuals continued to use Spanish frequently in their lives despite reporting English use for thinking. The assimilated (Class 5) were those living in the US 10 or more years and had the highest conditional probability to speak only English as a child. The majority of the assimilated exclusively spoke English only as a child, to read and speak, at home, to think, and with friends.

Assimilation in first generation individuals can be stressful, compared to subsequent generations (24, 53). The process of
assimilation in subsequent generations is often classified as either congruent or dissonant between parents and children (54). The assimilated classes from our findings could be indicative of second or subsequent generations of Hispanics/Latinos in our sample. Findings suggest a generational effect in the partial assimilation (Class 4) and assimilation (Class 5) as the profiles have an overall lower probability of using Spanish and a higher probability of speaking more English as children, respectively, to other profiles. The partially assimilated primarily had a higher probability of speaking more English than Spanish as children (i.e., 35.5% conditional probability). To contrast, the assimilated profile had the highest probability to speak English only as children (68.9% conditional probability).

Overall, using our LCA on a US representative sample of Hispanic/Latinos we identified heterogenous classes of acculturation that may reveal differences in experiences and processes, which were theoretically suggested in the literature. Linguistic acculturation can be a powerful indicator of risk, but more may be needed to detect telomere length differences between subgroups. While various reasons can be attributed as to why significant telomere differences were not detected, linguistic acculturation may be indicative of other psychosocial stressors and adaptive strategies. For instance, while language can be a source of insecurities and discrimination it can also be key to facilitate equitable access to healthcare and mental health services. In context of our findings, the largest subgroup was low acculturated with almost exclusive Spanish use while having lived in the US for 5 or more years. This may be indicative that a large proportion of US Hispanics/Latinos speak only Spanish, which may affect their access and quality of health services. Nonetheless, linguistic interventions will not be enough to mitigate the possible disparity. Spanish interpreters or translated health materials are a start but literacy and cultural empathy are critical to intervene or prevent excess risk by incorporating customs, norms, and behaviors that are conducive to health among US Hispanics/Latinos. To mitigate disparities and promote health equity, future studies must collect environmental and community data, as well as biomarkers of risk to create more comprehensive models. These comprehensive models may be used to confirm if profiles from our findings remain consistent or detect telomeric differences. Telomere differences may be indicative of increased morbidity and mortality among certain subpopulations (55). As such, the importance of detecting telomere length by acculturation may, for instance, be the critical difference in identifying cancer risk or preventing cancer among Mexican Americans (56). Lastly, in using more comprehensive person-level approaches we can model risk contextually to not only understand syndemic vulnerabilities—the synergy of disease outcomes interacting with comorbid conditions, as well as other social, cultural, biological, and environmental determinants in context of human rights (57)—but to also help develop tailored interventions and prevention programs for those at increased risk from among the most at-risk (24, 47, 53, 54).

LIMITATIONS AND STRENGTHS

Our study had four major limitations. The first was that the data, although nationally representative, were cross-sectional; therefore, we were unable to examine changes within the sample over time. Still, various published studies and reports have demonstrated that the data are of acceptable quality (11–13, 58). Second, acculturation is a complex, dynamic multidimensional process. Acculturation measures that exclusively use linguistic measures to assess the process have been critiqued (30, 53). Nonetheless, the validated SASH measure serves as a measure to assess a facet of acculturative strategies (29). Third, the telomere data were not from the current NHANES as they are only accessible from the 1999–2002 cycles. The fourth limitation concerns the meaningfulness of telomere length data in health outcomes research. While telomere research continues to be refined, the interpretation of telomere length and outcomes on morbidity and mortality are less direct (11–13, 59) and may explain why no significant telomere length differences were detected. Although more advanced methods from a manual BCH auxiliary regression approach in Mplus (37) would allow us to test the effects of covariates on classes, we would not be able to test differences of telomere length by class. Additionally, the manual approach would not permit us to test telomere length differences between profiles.

Our study also possessed notable strengths, as it is among the first to focus on acculturation and telomere length, a complex biomarker of senescence and risk. We used the most current techniques for available software packages to assess acculturation profiles and biological processes using complex survey design data of US Hispanics/Latinos. Future research will incorporate multiple acculturation factors beyond language measures to assess its impact on health biomarkers in the context of syndemic vulnerability and risk. A syndemic and latent variable approach will be critical as various factors co-occur and synergize to affect biological processes occurring in tandem without a priori categorization to capture person-centered contexts.

CONCLUSION

We identified five Hispanic/Latino acculturation profiles at possible differential risk of shorter telomere length, but no significant telomere length differences emerged. Specifically, our findings will contribute to the emerging literature on the relationship between acculturation profiles and associated biomarkers of health and disease. Our findings and approach provide a way to identify groups most at-risk in already vulnerable subpopulations. Through this work we can understand contextual risk, as well as develop prevention programs and targeted health interventions among US Hispanic/Latino groups. The implications of this research will be to examine the dynamic effects of acculturation using comprehensive models of risk biomarkers to develop prevention programs in order to mitigate health disparities and move toward health equity.
DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: https://www.cdc.gov/nchs/nhanes/Default.aspx.

AUTHOR CONTRIBUTIONS

FM: conceptualization, data curation, methodology, formal analysis, visualization, roles, writing—original draft, and writing—review and editing. PM: roles, writing—original draft, conceptualization, and writing—review and editing. KV: conceptualization and writing—review and editing. JC: resources, roles, writing—original draft, supervision, and validation. AN: roles, writing—original draft, writing—review and editing, supervision, and validation. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.640226/full#supplementary-material.
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49. Montiel Ishino et al. Hispanic/Latino Acculturation Profiles and Telomeres

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