

Subjective Uncertainty About Future Life Events in the American Family Health Study (AFHS)

Abstract

Background: Subjective uncertainty about future life events is a common yet understudied phenomenon. Individuals often assess the likelihood of experiencing significant outcomes—such as financial instability, relationship changes, or health issues—using personal probability judgments rather than binary expectations. These probabilistic beliefs shape planning behavior, perceived uncertainty and control, and well-being. Studying how demographic and socioeconomic factors relate to these perceptions can inform targeted policy and communication strategies.

Methods: We analyzed subjective probability outcomes using survey-weighted proportional odds cumulative logit regression models in 900 respondents from the American Family Health Study (2020–2022). Covariates (age, sex, educational attainment, race, Hispanic ethnicity, and parental marital status at birth) were specified a priori, and candidate model terms were evaluated using nested model comparisons via likelihood ratio tests. Population-representative point estimates used final survey weights, and uncertainty was quantified using 200 bootstrap replicate weights to account for the complex survey design.

Results: Subjective probabilities were not uniformly distributed across response categories and varied by respondent characteristics. Educational attainment was strongly associated with perceived ability to pay bills (college or higher vs less than high school: OR = 0.14, 95% CI: 0.07–0.30) and with perceived probability of death over the next 12 months (college or higher vs less than high school: OR = 2.94, 95% CI: 1.43–6.06). Perceived probability of having a child differed by age and marital history (age: OR = 1.12, 95% CI: 1.06–1.18; ever married vs never married: OR = 0.39, 95% CI: 0.23–0.66), with evidence that parental marital status modified the age association (interaction OR = 0.94, 95% CI: 0.89–1.00). Overall, these results indicate meaningful heterogeneity in expectations across demographic and socioeconomic groups in this cohort.

Introduction

Uncertainty about future life events shapes decision-making and well-being. People form subjective probabilities—their best guesses—about financial stability, health risks, and major life changes, and these beliefs influence choices from budgeting to health behaviors. Although informative, subjective probabilities have been less commonly used in large population surveys, in part because they are difficult to measure consistently and respondents may interpret response scales differently (AFHS, 2022). Recent survey design advances have improved the feasibility of collecting these measures nationally, complementing objective indicators such as income, health status, and demographics by capturing perceived risk and security.

The American Family Health Study (AFHS) includes five subjective probabilities for events in the next 12 months: ability to pay bills, marriage or cohabitation, relationship dissolution, childbearing, and death. Examining how these probabilities vary across demographic and socioeconomic groups can reveal broader differences in perceived stability and risk.

This study estimates population-level associations between demographic and socioeconomic characteristics and subjective probabilities of these five events using nationally representative AFHS data and methods that account for the complex survey design. Our research question is: How do subjective probabilities of five life events over the next 12 months vary by respondents' demographic and socioeconomic characteristics?

Methods

Study Design:

The AFHS was conducted from 2020 to 2022 and collected data from a national probability sample of U.S. adults aged 18–49. Sampled households were first invited to complete a brief online screening questionnaire about household members; if an eligible adult was identified, one eligible individual per household was randomly selected to complete the main AFHS survey online (or by mail) on family life, health, and related topics (AFHS, 2022). A follow-up data collection was conducted among respondents from the second AFHS replicate to pilot measures of subjective probabilities (Saw et al., 2023). Of 1,348 eligible respondents, 900 completed the follow-up survey (66.8% response rate) (Saw et al., 2023). Sample sizes varied across outcomes due to item nonresponse and skip patterns by design. All analyses incorporated final survey weights

and bootstrap replicate weights from the original study to produce population-representative estimates and valid variance estimation under the complex sampling design.

For this study, subjective probability outcomes were analyzed as ordinal variables to reflect the ordered response categories (Wieditz et al., 2024). For interpretability, the original 11-point response scale was collapsed into five ordered probability bands, grouping adjacent response options to preserve ordinal structure while reducing category redundancy (Lee and Paek, 2014). Figure 1 displays the distribution of responses across the five future life events examined in this study. Covariates were specified *a priori* based on the literature and substantive relevance and included age (mean-centered at 34 years old), sex, educational attainment, race, Hispanic ethnicity, and parental marital status at birth ever-married status, which recoded into substantively meaningful categories where appropriate. Due to very small cell counts (NHPI, $n = 1$), NHPI was combined with [Asian / Other] to ensure stable estimation in regression models. Educational attainment was grouped into four levels (<high school, high school, some college, and college or higher). Covariate missingness was minimal (<1% for all covariates); therefore, regression analyses used complete cases for covariates. Subjective probability outcomes differed in eligibility: the pay bills, pass away, and have child outcomes were administered to all respondents, whereas get married and end of relationship were administered conditionally based on marital/relationship status, so missingness in these outcomes primarily reflects skip patterns. For each outcome, models were fit on respondents eligible for that outcome with non-missing outcome responses, complete covariate data, and valid survey weights. Outcome-specific analytic sample sizes are reported in Table A2, and missingness patterns are shown in Figure 2.

Statistical Methods:

Weighted descriptive statistics were computed to summarize the demographic and socioeconomic characteristics of the analytic sample. Continuous variables are reported as weighted means (SD), and categorical variables are reported as unweighted counts with weighted percentages; missing values are shown as separate categories (Table 1). Subjective probability outcomes were modeled as ordinal responses using proportional odds cumulative models (Agresti, 2010).

Prior to survey-weighted estimation, we evaluated alternative model specifications using unweighted proportional

odds cumulative link models. Candidate interaction terms were assessed during model development, while retaining pre-specified core covariates for adjustment. Because some covariates are substantively important regardless of statistical significance (e.g., age in mortality-related outcomes), pre-specified core covariates were retained in all models and variable inclusion was not based on p -values alone. For each outcome, we then fit a survey-weighted proportional odds cumulative model. This approach leverages the ordinal structure to estimate covariate effects that shift responses toward higher versus lower categories, rather than treating response categories as nominal. Point estimates were obtained using the final survey weights.

Candidate interaction terms were evaluated during model development. For outcomes where interaction terms were not supported, we report reduced models excluding those interactions to improve parsimony and interpretability. The final model for perceived likelihood of death in the next 12 months included age, sex, educational attainment, and an age-by-education interaction. The final model for perceived ability to pay bills included age, educational attainment, and an age by education interaction. The final model for perceived likelihood of having a child included age, ever-married status, parental marital status at birth, and an age by parental marital-status interaction. The final model for perceived likelihood of marriage or cohabitation included race/ethnicity, age, and a race/ethnicity-by-age interaction. The final model for perceived likelihood of relationship dissolution included ever-married status and parental marital status at birth.

Uncertainty was estimated using bootstrap replicate weights to obtain bootstrap standard errors for model coefficients. Results are reported as odds ratios (ORs), obtained by exponentiating regression coefficients, with Wald 95% confidence intervals computed using bootstrap standard errors.

All analyses were performed using R statistical software, version 4.5.2 (www.R-project.org). Cumulative probability (proportional odds) regression models were implemented using the VGAM package (Yee, 2015). Statistical significance was set at $p < 0.05$ for all tests unless otherwise specified.

Results:

Summary of weighted descriptive characteristics of the AFHS follow-up sample (unweighted $N = 900$) in Table 1. Respondents had a mean age of 34.1 years (SD 9.2) and were 51.2% female. Respondents reported a mean highest grade completed of 14.4 (SD 2.5). The weighted sample was predominantly White

(75.7%), followed by Black (15.1%), Asian (6.9%), and AIAN (2.8%); 17.8% reported Hispanic ethnicity. Most respondents reported that their parents were married at birth (79.5%). Subjective probabilities were not uniformly distributed across response categories (Table 1 and Table A1). PayBills responses were concentrated in the “very high chance (80–100%)” category (59.9%), whereas PassAway responses were concentrated in the “very low chance (0–20%)” (40.3%) and “low chance (30–40%)” (29.8%) categories (Table 1). In contrast, HaveChild responses were heavily concentrated in the “very low chance (0–20%)” category (77.2%) (Table A1). For GetMarried and EndOfRel, a substantial proportion of responses were coded as missing (61.1% and 39.4%, respectively), consistent with conditional administration of these items (Table A1).

For the PayBills outcome (Table A5), we found that among respondents of the same age (34 years old), we estimate that having a high school education (vs < HS) is associated with a decrease in the odds of being very low chance to pay the bills in the next 12 months by a factor of 0.47 (95% CI: 0.22-1), compared to respondents is less than high school education. Among respondents of the same age (34 years old), we estimate that having a some college education (vs < HS) is associated with a decrease in the odds of being very low chance to pay the bills in the next 12 months by a factor of 0.29 (95% CI: 0.14-0.59), compared to respondents is less than high school education. Among respondents of the same age (34 years old), we estimate that having a college and more education (vs < HS) is associated with a decrease in the odds of being very low chance to pay the bills in the next 12 months by a factor of 0.14 (95% CI: 0.07-0.3), compared to respondents is less than high school education. For the PassAway outcome (Table A7), among respondents of the same age (34 years old), we estimate that having some college (vs < HS) is associated with a increase in the odds of being very low chance to pass away in the next 12 months by a factor of 2.83 (95% CI: 1.4-5.73), compared to respondents is less than high school education. Among respondents of the same age (34 years old), we estimate that having a college or more education (vs < HS) is associated with a increase in the odds of being very low chance to pass away in the next 12 months by a factor of 2.94 (95% CI: 1.43-6.06), compared to respondents is less than high school education. For the HaveChild outcome (Table A8), we estimate that a one-year increase in age is associated with a increase in the odds of being very low chance to have child in the next 12 months by a factor of 1.12 (95% CI: 1.06–1.18). Among respondents

of the same age (34 years old), We estimate that being ever married is associated with a decrease in the odds of being very low chance to have child in the next 12 months by a factor of 0.39 (95% CI: 0.23–0.66), compared to never married. Among respondents with parents is married at birth, the effect of a one-year increase in age on the odds of being very low chance to have child in the next 12 months is decreased by a factor of 0.94 (95% CI: 0.89–1.00), compared with respondents parents is not married at birth. For the GetMarried outcome (Table A10), we estimate that Asian/NHPI people (vs AIAN Race) is associated with a increase in the odds of being very low chance to get married in the next 12 months by a factor of 9.79 (95% CI: 1.46–65.57), compared to respondents who are AIAN. For the EndOfRel outcome (Table A11), we did not detect any statistically significant associations.

Conclusion

Subjective probabilities for five life events over the next 12 months varied systematically by demographic and socioeconomic characteristics among U.S. adults aged 18–49 in the AFHS follow-up period (2020–2022). Education was a consistent correlate of perceived ability to pay bills and perceived likelihood of death, suggesting that socioeconomic position is linked to how respondents evaluate short-term financial stability and mortality risk. Expectations about having a child were strongly patterned by age and marital history, with evidence that parental marital status at birth modified the age association for having a child. Partnership expectations also differed across groups, with perceived likelihood of marriage/cohabitation varying by race/ethnicity.

Several limitations should be considered. First, small subgroup sample sizes (e.g., NHPI) required collapsing categories to support stable estimation, limiting subgroup-specific inference and contributing to imprecise estimates for some comparisons. Second, outcomes were self-reported subjective probabilities measured on a collapsed ordinal scale; respondents may interpret response categories differently, and collapsing the original scale trades detail for interpretability and may reduce sensitivity to smaller differences.

Future work could examine these associations using the full response scale and assess whether response-category interpretation differs across demographic groups, and could also evaluate more flexible ordinal modeling approaches (e.g., partial proportional odds) to test whether covariate effects vary across thresholds.

Generative AI Statement

ChatGPT was used to assist with debugging and fixing R code for the statistical analysis, improving wording and translations, and resolving LaTeX/Overleaf formatting issues. ChatGPT also used in reduce length in introduction and conclusion. Gemini was used to generate one presentation image (slide 3 on the left).

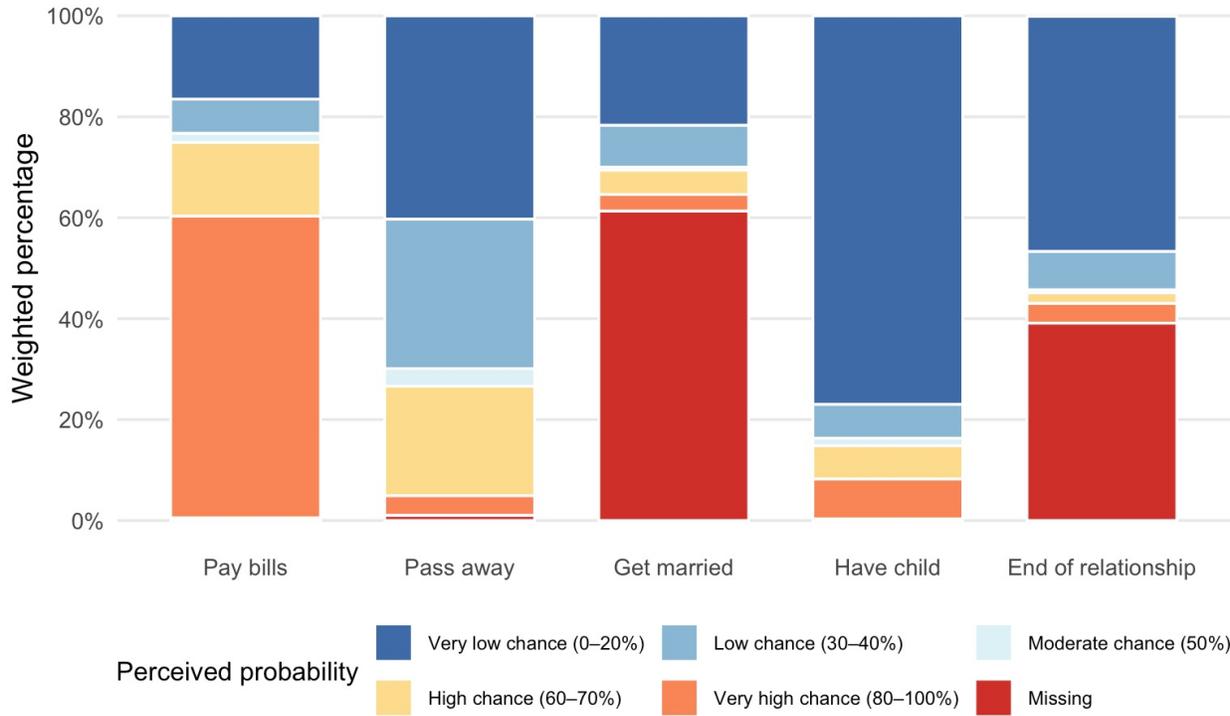


Figure 1: Distribution of subjective probability responses across five future life events in the AFHS follow-up sample. Responses were recorded on an 11-point scale and collapsed into five ordered categories (very low, low, moderate, high, and very high probability) for presentation. Bars represent weighted percentages using final survey weights. Missing responses are shown as a separate category.

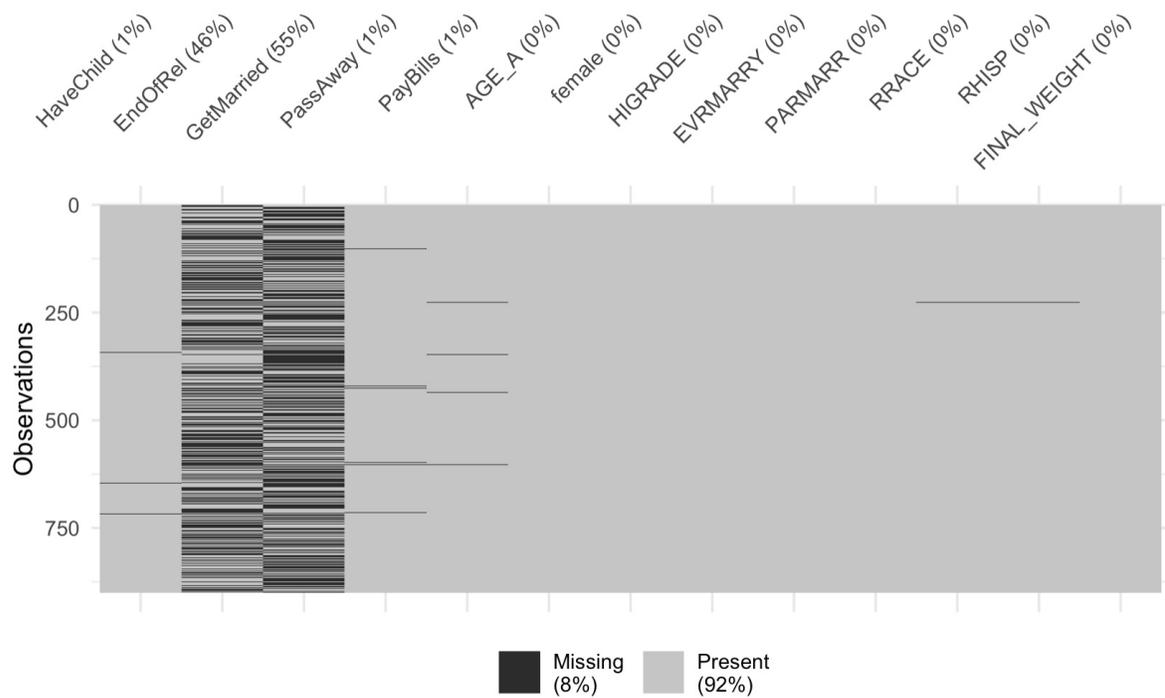


Figure 2: Missing data patterns across study variables. Each row represents a respondent and each column a study variable. Dark cells indicate missing values and light cells indicate observed values. Three outcome variables (GetMarried, EndOfRel, HaveChild) were administered conditionally based on respondents' relationship status; missingness in these variables therefore reflects survey skip patterns rather than item nonresponse.

Table 1: Weighted descriptive characteristics of respondents in the AFHS follow-up sample (unweighted $N = 900$). Missing values are shown as separate categories.

Characteristic	Total ($N = 900$)
Age (years)*	34.1 (9.2)
Education (highest grade)*	14.4 (2.5)
Sex	
Male	366 (48.8)
Female	534 (51.2)
Missing	0 (0.0)
Race	
AIAN	31 (2.8)
Asian/NHPI	70 (6.9)
Black	140 (15.3)
White	656 (74.7)
Missing	3 (0.3)
Hispanic ethnicity	
Non-Hispanic	765 (82.0)
Hispanic	134 (17.9)
Missing	1 (0.0)
Parental marital status	
Parents not married	156 (20.4)
Parents married	742 (79.3)
Missing	2 (0.3)
Perceived ability to pay bills (next 12 months)	
Very low chance (0–20%)	115 (16.4)
Low chance (30–40%)	69 (6.8)
Moderate chance (50%)	15 (1.8)
High chance (60–70%)	122 (14.7)
Very high chance (80–100%)	573 (59.9)
Missing	6 (0.5)
Perceived probability of death (next 12 months)	
Very low chance (0–20%)	378 (40.3)
Low chance (30–40%)	300 (29.8)
Moderate chance (50%)	25 (3.5)
High chance (60–70%)	160 (21.6)
Very high chance (80–100%)	29 (3.8)
Missing	8 (1.0)

Note: * Continuous variables are reported as mean (SD). All Categorical variables are reported as unweighted N (weighted %).

Table 2: Survey-weighted proportional odds models across outcomes (5-category outcomes).

Predictor	PayBills (n=890)	PassAway (n=887)	HaveChild (n=890)	GetMarried (n=403)	EndOfRel (n=485)
Age	1.00 (0.98, 1.02)	0.98 (0.96, 1.00)	1.12 (1.06, 1.18)	1.00 (0.98, 1.02)	—
Ever married (ref: never married)	—	—	0.39 (0.23, 0.66)	—	1.47 (0.36, 5.97)
Education (ref: < HS)					
High school	0.47 (0.22, 1.00)	1.71 (0.81, 3.64)	—	—	—
Some college	0.29 (0.14, 0.59)	2.83 (1.40, 5.73)	—	—	—
College+	0.14 (0.07, 0.30)	2.94 (1.43, 6.06)	—	—	—
Parents married at birth (ref: No)					
Yes	—	—	0.88 (0.52, 1.50)	—	1.16 (0.45, 2.99)
Age × Parents married at birth (ref: No)					
Age × Yes	—	—	0.94 (0.89, 1.00)	—	—
Race (ref: AIAN)					
Asian/NHPI	—	—	—	9.79 (1.46, 65.57)	—
Black	—	—	—	2.01 (0.41, 9.90)	—
White	—	—	—	3.70 (0.86, 15.96)	—
Ever married × Parents married at birth	—	—	—	—	1.21 (0.27, 5.40)

Note. Note. Age centered at 34. Entries are odds ratios with 95% confidence intervals. Each outcome was modeled separately, so predictors differ across columns; “—” indicates the predictor was not included in the final model for that outcome. Estimates use final survey weights; 95% CIs use 200 bootstrap replicate weights. Bold indicates $p < 0.05$. PayBills, PassAway, and GetMarried report no-interaction models for interpretability; HaveChild and EndOfRel report interaction models due to significant interactions.

References

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Appendix

Table A1: Weighted distributions of additional subjective probability outcomes in the AFHS follow-up sample (unweighted $N = 900$). Categorical variables are unweighted N (weighted %).

Outcome category	Total ($N = 900$)
Perceived probability of having a child (next 12 months)	
Very low chance (0–20%)	674 (77.2)
Low chance (30–40%)	72 (6.7)
Moderate chance (50%)	13 (1.5)
High chance (60–70%)	57 (6.5)
Very high chance (80–100%)	79 (7.8)
Missing	5 (0.3)
Perceived probability of getting married (next 12 months)	
Very low chance (0–20%)	205 (21.8)
Low chance (30–40%)	90 (8.3)
Moderate chance (50%)	9 (0.6)
High chance (60–70%)	63 (5.0)
Very high chance (80–100%)	39 (3.3)
Missing	494 (61.1)
Perceived probability of relationship ending (next 12 months)	
Very low chance (0–20%)	386 (46.5)
Low chance (30–40%)	60 (7.6)
Moderate chance (50%)	6 (0.6)
High chance (60–70%)	14 (2.1)
Very high chance (80–100%)	21 (3.9)
Missing	413 (39.4)

Table A2: Final analytic sample sizes by outcome (complete-case, outcome-eligible respondents).

Outcome	Final analytic N
Pay bills (<i>PayBills</i>)	890
Die from any cause (<i>PassAway</i>)	887
Take steps to have a child (<i>HaveChild</i>)	890
Get married / move in with a partner (<i>GetMarried</i>)	403
Relationship ends (<i>EndOfRel</i>)	485

Notes: Total follow-up sample $N = 900$.

Table A3: Variable coding and missingness summary (AFHS follow-up).

Variable	Type used	Coding / recode	Missing (%)
Age	Continuous	Age in years; mean-centered in models	0.0
Sex	Categorical	Male / Female	0.0
Ever-married status	Categorical	Ever married / Never married	0.0
Education	Categorical	<HS / HS / Some college / College+	0.2
Race	Categorical	AIAN / Asian / NHPI / Black / White	0.3
Hispanic ethnicity	Categorical	Non-Hispanic / Hispanic	0.1
Parental marital status at birth	Categorical	Parents not married / married	0.2
PayBills	Ordinal outcome	0–10 (coded 1–11), collapsed to 5 ordered bands	0.7
PassAway	Ordinal outcome	0–10 (coded 1–11), collapsed to 5 ordered bands	0.9
HaveChild	Ordinal outcome	0–10 (coded 1–11), collapsed to 5 ordered bands	0.6
GetMarried	Ordinal outcome	0–10 (coded 1–11), collapsed to 5 ordered bands	55
EndOfRel	Ordinal outcome	0–10 (coded 1–11), collapsed to 5 ordered bands	46

Note: *GetMarried* and *EndOfRel* were asked conditionally (skip patterns); outcome-specific analytic sample sizes are therefore smaller for these outcomes.

Table A4: Survey-weighted proportional odds model for *PayBills* (5-category outcome; Sample size = 890).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	0.97	(0.89, 1.06)	0.486
Education (ref: < HS)			
High school	0.44	(0.20, 0.98)	0.043
Some college	0.26	(0.13, 0.55)	< 0.001
College+	0.13	(0.06, 0.29)	< 0.001
Age × Education (ref: < HS)			
Age × High school	1.06	(0.96, 1.16)	0.229
Age × Some college	1.02	(0.93, 1.11)	0.681
Age × College+	1.05	(0.96, 1.15)	0.320

Note. Age was centered at 34 years (i.e., $AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A5: Survey-weighted proportional odds model without interaction for *PayBills* (5-category outcome; Sample size = 890).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	1.00	(0.98, 1.02)	0.797
Education (ref: < HS)			
High school	0.47	(0.22, 1)	0.049
Some college	0.29	(0.14, 0.59)	< 0.001
College+	0.14	(0.07, 0.3)	< 0.001

Note. Age was centered at 34 years (i.e., $AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A6: Survey-weighted proportional odds model for *PassAway* (5-category outcome; Sample size = 887).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	0.93	(0.86, 1.01)	0.104
Education (ref: < HS)			
High school	1.47	(0.66, 3.28)	0.340
Some college	2.36	(1.13, 4.94)	0.023
College+	2.55	(1.19, 5.49)	0.016
Age × Education (ref: < HS)			
Age × High school	1.09	(0.99, 1.20)	0.075
Age × Some college	1.03	(0.94, 1.12)	0.535
Age × College+	1.07	(0.98, 1.18)	0.130

Note. Age was centered at 34 years ($AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A7: Survey-weighted proportional odds model without interaction for *PassAway* (5-category outcome; Sample size = 887).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	0.98	(0.96, 1.00)	0.080
Education (ref: < HS)			
High school	1.71	(0.81, 3.64)	0.162
Some college	2.83	(1.4, 5.73)	0.004
College+	2.94	(1.43, 6.06)	0.003

Note. Age was centered at 34 years ($AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A8: Survey-weighted proportional odds model for *HaveChild* (5-category outcome; Sample size = 890).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	1.12	(1.06, 1.18)	< 0.001
Ever married (ref: never married)	0.39	(0.23, 0.66)	< 0.001
Parents married at birth (ref: No)			
Yes	0.88	(0.52, 1.50)	0.636
Age × parents married at birth (ref: No)			
Age × Yes	0.94	(0.89, 1.00)	0.033

Note. Age was centered at 34 years ($AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A9: Survey-weighted proportional odds model for *GetMarried* (5-category outcome; Sample size = 403).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	1.02	(0.73, 1.42)	0.930
Race (ref: AIAN)			
Asian/NHPI	8.40	(1.28, 55.29)	0.027
Black	1.95	(0.43, 8.84)	0.388
White	3.45	(0.87, 13.67)	0.078
Age × Race (ref: AIAN)			
Age × Asian/NHPI	0.97	(0.68, 1.39)	0.866
Age × Black	1.00	(0.71, 1.39)	0.978
Age × White	0.98	(0.7, 1.37)	0.897

Note. Age was centered at 34 years ($AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A10: Survey-weighted proportional odds model without interaction for *GetMarried* (5-category outcome; Sample size = 403).

Predictor	OR	95% CI	p-value
Age (per 1 year, centered at 34)	1.00	(0.98, 1.02)	0.761
Race (ref: AIAN)			
Asian/NHPI	9.79	(1.46, 65.57)	0.019
Black	2.01	(0.41, 9.9)	0.388
White	3.70	(0.86, 15.96)	0.080

Note. Age was centered at 34 years ($AGE_c = AGE - 34$). Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.

Table A11: Survey-weighted proportional odds model for *EndOfRel* (5-category outcome; Sample size = 485).

Predictor	OR	95% CI	p-value
Ever married (vs never married)	1.47	(0.36, 5.97)	0.593
Parents married at birth (Yes vs No)	1.16	(0.45, 2.99)	0.766
Ever married × Parents married at birth	1.21	(0.27, 5.40)	0.800

Note. Point estimates are from the final survey weight, and 95% CIs and p-values are based on 200 bootstrap replicate weights.