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Descriptive Finding

Racial classification as a multistate process

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Descriptive Finding

Racial classification as a multistate process

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Abstract

BACKGROUND

Although the existence of racial fluidity is generally accepted in both Brazil and the United States, changes in racial classification over the life course are often not incorporated into standard demographic estimates.

OBJECTIVE

By taking a multistate perspective on the variability of racial classification, we can use demographic methods to ask new questions about the nature of racial fluidity, such as: How many years can someone classified as White, Brown, or Black at birth expect to live in a different racial category? At what ages are changes in racial classification more likely to occur?

METHODS

We compute multistate life tables using linked data from Brazil's largest household survey (2017–2019 PNAD-C) to estimate transition probabilities between the White, Brown, and Black race categories, which we combine with age- and race-specific mortality probabilities.

RESULTS

Transition probabilities reveal that up to age 65, Brazilians are more likely to be reclassified from either White or Black to Brown than they are to die at each age. Conditional life expectancy estimates show that Brazilians who were classified as Black at birth can expect to live almost 15 years of their lives classified as White, while those classified as White at birth can expect to live, on average, three years classified as Black.

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CONTRIBUTION
We provide important new evidence on the extent of racial fluidity in contemporary Brazil and demonstrate the feasibility of accounting for this fluidity in traditional demographic analysis.

1. Introduction

It has become a truism to say that race is a socially defined and therefore potentially variable characteristic. The fluidity of racial classifications, not only across historical time but also within an individual's life course, has been well documented both in the United States (Agadjanian 2022; Dahis, Nix, and Qian 2019; Liebler et al. 2017; Saperstein and Gullickson 2013) and in Latin America (Davenport 2020), with Brazil highlighted as the most paradigmatic case due to its high level of racial fluidity (Carvalho, Wood, and Andrade 2004; Cornwell, Rivera, and Schmutte 2017; Miranda 2015; Muniz and Bailey 2022; Senkevics 2022; Silveira 2019). Yet this fluidity is seldom explicitly incorporated in demographic research, despite its implications for understanding racial inequality (Roth, Solís, and Sue 2022; Saperstein and Penner 2012).

Here we consider improved estimates of race-specific mortality and transition probabilities to account for the variability of racial classification over the life course from a multistate perspective. Multistate life tables allow us to treat racial classifications as nonpermanent states, in which individuals may spend only part of their lives. The added virtue of multistate life tables lies in their ability to answer questions that a conventional single decrement life table cannot, such as: What is the number of years that a cohort can expect to live in a given state (in this case a race category)? What is the probability of dying in a given race category? What proportion of life will be spent in a given race category? How many years will people classified as White, Brown, or Black at birth spend in these same states? This is the first time that racial classification is treated as a multistate process over the life cycle, thus measuring and emphasizing the changeability of race as a social construct.

2. Data

We use longitudinal data from the Continuous National Household Sample Survey (PNAD-C), conducted by the Brazilian Institute of Geography and Statistics (IBGE) between 2017 and 2019, to estimate transition probabilities between the White, Brown, and Black race categories (*branco/a*, *pardo/a*, and *preto/a* in Portuguese). We retrieved the PNAD-C data using `datazoom_social` (Data Zoom 2023). For the history of race/color classification in Brazil, see Daniel (2006), Loveman (2014), Nobles (2000), and Telles (2004, 2015).

Each quarter, about 211,000 households are interviewed, covering about 16,000 census sectors in 3,500 municipalities. The PNAD-C has a rotational unbalanced panel design in which selected households are interviewed for one month and leave the sample for the next two months, and this sequence is repeated five times. Selected households are thus interviewed for five quarters. This produces a series of observations for each household and respondent, including race reports for each person at each time point. One person (usually the household head) is responsible for responding to the survey questionnaire on behalf of all members living in the household. Reported race therefore can be either self-identification or classification by a family member. In Brazil, agreement between interviewer and respondent self-classifications is around 80% (Telles 2002, 2014), and agreement among family members is likely to be higher, as they are likely to share perspectives on their racial identity. For this reason, our analysis does not distinguish between individuals whose race was self-reported or was reported by another member of the same household, and we use the more generic term *racial classification* to refer to resulting data. Although some of the classification fluidity we observe may result from different perceptions among household members, we take steps to eliminate forms of measurement error (as described below) and maintain that the patterning of any remaining changes in classification is worthy of further study.

We use the algorithm proposed by Ribas and Soares (2009) to link individuals, as it accounts for potential measurement errors in reported characteristics and increases the likelihood of identifying the same individuals. Unique identifiers link households across successive surveys, but matching households by household identification number and survey month may result in false matches. If all members of the household move out and new members move in between survey periods, in the later survey, these individuals would have the same household identification number as the previous residents. For this reason, we also use the sex, date of birth, and years of education of residents to identify potentially the same person in different waves of the survey (Miranda 2015; Queiroz 2007; Ribas and Soares 2009). Once individuals are linked, we generate panel data including children and adults of both sexes.

We also combine 2010–2019 death registration information, declared by the person responsible for the deceased (Ministério da Saúde 2021), with population counts from 2010 and 2020 to estimate age and race-specific life tables. The probabilities of racial transition (from PNAD-C) and mortality (using data from the Brazilian census, PNAD-C, and SIM) are then combined into a single matrix to estimate multistate life tables in which each state represents a race category (White, Brown or Black) or an absorbing state (death). Although it is also possible to be racially classified differently at death (Noymer, Penner, and Saperstein 2011), our data do not allow us to link individuals to their death records. Instead we rely on population averages to calculate race-specific mortality.

For replication purposes, the population counts, number of deaths, and probabilities of racial classification transitions, structured by five-year age groups and reported races, are available in the following public data repository: https://github.com/blanza/race_multistate.

3. Methods and results

Our methodological strategy consists of three steps. In the first, we compute racial classification transition probabilities by five-year age groups for Brazilians initially classified as White, Brown, or Black who were interviewed at least twice (and up to five times) between 2017 and 2019. We do not analyze transitions to or from the Asian or Indigenous categories as they represent less than 2% of the observations in our sample. In the second step, we estimate race-specific life tables by age to account for mortality, the absorbing state in our multistate framework. Finally, in the third step, we combine the racial classification transition probabilities and race-specific mortality to generate the input matrix of our multistate process, which allows us to examine the amount of time that synthetic birth cohorts would spend classified as White, Brown, or Black over their life cycles if the currently observed conditions remained the same. We also present summary measures for multistate life tables: the mean age, the probability of dying, the average duration, and the proportion of life spent in a specific state. Further details about the algorithms and formulas used to compute these measures and multistate life tables with the Stata program (`mslt`) are available in Muniz (2020).

3.1 Transition probabilities between race categories

Transition probabilities correspond to the relative row frequencies of the contingency table between the previous and most current reported race of individuals in Panel 6 of the 2017–2019 PNAD-C. Transition probabilities are thus drawn from all person-years with at least two racial classifications over a three-year period. We exclude cases with potential measurement error (where there is only one anomalous racial classification in the series), following Saperstein and Penner (2016), and we use survey sampling weights in our calculations to obtain accurate population estimates for the parameters of interest.

Muniz (2020) and Schoen (1988a) refer to transition probabilities as “survivorship proportions.” The difference between rates and survivorship proportions is that the latter are based on the same group of individuals observed longitudinally, whereas the former may not be. Formally, survivorship proportions are defined as

$$ {}_nS_x^{ij} = \frac{{}_nP_{x+n}^{ij}(t+n)}{{}_nP_x^{i}(t)}, \qquad (1) $$

where ${}_nP_x^{i}\,(t)$ is the number of persons in state i of the observed population between the ages of x and $x+n$ at time t, and ${}_nP^{ij}{}_{x+n}\,(t+n)$ is the number of persons in state j of the observed population between the ages of $x+n$ and $x+2n$ at time $t+n$ who were in state i exactly n years earlier (Schoen 1988a).

3.2 Race-specific mortality rates

The Brazilian vital registration system has several limitations (França et al. 2008; Queiroz et al. 2020), including underreporting of death counts and age misreporting. To overcome those limitations, we used the method proposed by Merli (1998). The approach triangulates between the methods proposed by Preston and Bennett (1983) and Bennett and Horiuchi (1984) – and later improved by Preston et al. (1996) – to overcome the bias implicit in the growth rates associated to the age distortions, differential coverage, and residual intercensal migration present in these earlier methods and to reconcile their results. The method assumes: (1) that the undercount of the population and deaths by age is constant and (2) that the initial population is correctly enumerated. Merli's method estimates mortality from a set of average registered deaths by age and age-specific growth rates derived from two population age distributions. We use the Stata program (`ilt`) written by Muniz (2023) to iteratively compute race-specific single decrement life tables (shown in Table 1).

Estimates presented in Table 1 are based on 2010 and 2020 race- and age-specific populations from IBGE. The 2010 data are from the Brazilian census, and the 2020 data are from the third quarter of the PNAD-C. The other required input to derive single-decrement life tables using Merli's (1998) iterative method is the average number of deaths reported by the Ministry of Health between 2010 and 2019 (Ministério da Saúde 2021).

Table 1: Life tables by racial classification

	Whites				Browns				Blacks			
Age group	dx	lx	qx	ex	dx	lx	qx	ex	dx	lx	qx	ex
0–4	17,865	1,057,855	0.0169	72.57	19,939	809,087	0.0246	68.02	1,118	81,067	0.0138	66.96
5–9	1,412	1,039,990	0.0014	68.80	1,689	789,148	0.0021	64.72	160	79,949	0.0020	62.89
10–14	1,816	1,038,578	0.0017	63.89	2,245	787,460	0.0029	59.85	243	79,789	0.0030	58.01
15–19	5,599	1,036,762	0.0054	59.00	9,206	785,215	0.0117	55.01	946	79,546	0.0119	53.18
20–24	7,546	1,031,163	0.0073	54.31	11,942	776,009	0.0154	50.64	1,167	78,601	0.0148	48.79
25–29	7,544	1,023,617	0.0074	49.69	11,693	764,067	0.0153	46.39	1,132	77,434	0.0146	44.49
30–34	8,643	1,016,073	0.0085	45.04	12,698	752,374	0.0169	42.07	1,278	76,302	0.0167	40.11
35–39	10,779	1,007,430	0.0107	40.40	14,696	739,676	0.0199	37.75	1,580	75,024	0.0211	35.75
40–44	14,811	996,651	0.0149	35.81	18,217	724,980	0.0251	33.47	2,087	73,445	0.0284	31.46
45–49	21,600	981,840	0.0220	31.32	24,279	706,762	0.0344	29.26	2,897	71,358	0.0406	27.31
50–54	31,877	960,240	0.0332	26.96	32,654	682,483	0.0478	25.22	4,041	68,460	0.0590	23.36
55–59	46,014	928,364	0.0496	22.80	43,438	649,829	0.0668	21.36	5,375	64,420	0.0834	19.67
60–64	65,427	882,350	0.0742	18.86	57,049	606,391	0.0941	17.71	6,855	59,045	0.1161	16.23
65–69	89,725	816,923	0.1098	15.17	73,460	549,342	0.1337	14.29	8,371	52,190	0.1604	13.04
70–74	120,592	727,198	0.1658	11.74	91,852	475,882	0.1930	11.11	9,801	43,819	0.2237	10.05
75–79	154,871	606,606	0.2553	8.57	109,938	384,031	0.2863	8.17	10,621	34,017	0.3122	7.22
80+	451,735	451,735	1	5.65	274,093	274,093	1	5.44	23,396	23,396	1	4.37

Notes: Estimates were produced using `ilt`, a Stata program developed by Muniz (2023). A data repository, for replicability of results, is available at: https://github.com/blanza/race_multistate.
Sources: Population data are from the 2010 Brazilian census. The 2020 population was extracted from the third quarter of the 2020 PNAD-C microdata. The average annual number of deaths between 2010 and 2019 was retrieved from Ministério da Saúde (2021).

3.3 Multistate life tables

Increment-decrement life tables allow for calculation of “the amount of time that individuals of a cohort will spend in a given state of occupancy” (Muniz 2020; Rogers, Rogers, and Belanger 1989; Schoen 1988b). When individuals are exposed to various recurring events or transitions throughout their lives and when people switch among multiple statuses through time, sometimes leaving and then returning to the same state, increment-decrement life tables are used to calculate life expectancy in each state (Kuo, Suchindran, and Koo 2008). Our multistate life table estimates combine transition probabilities for racial classification with the race-specific probabilities of dying (qx) shown in Table 1. After partitioning these combined probabilities to sum to 1 and ensuring that racial fluidity occurs only among those who are alive, we obtain a transition matrix between White (W), Brown (Br), Black (B), and dead (D) states (shown in Table 2).

Table 2: Age-specific transition probabilities between race categories and death

Age group	W --> Br	W --> B	W --> D	Br --> W	Br --> B	Br --> D	B --> W	B --> Br	B --> D
0–4	0.1286	0.0044	0.0166	0.0882	0.0262	0.0241	0.0338	0.2627	0.0136
5–9	0.1392	0.0053	0.0014	0.0799	0.0301	0.0021	0.0277	0.2855	0.0020
10–14	0.1425	0.0056	0.0017	0.0763	0.0333	0.0028	0.0270	0.2862	0.0030
15–19	0.1407	0.0057	0.0054	0.0769	0.0371	0.0116	0.0239	0.2797	0.0117
20–24	0.1266	0.0061	0.0073	0.0768	0.0383	0.0152	0.0247	0.2542	0.0146
25–29	0.1133	0.0059	0.0073	0.0758	0.0378	0.0151	0.0265	0.2372	0.0144
30–34	0.1109	0.0065	0.0084	0.0733	0.0386	0.0166	0.0268	0.2307	0.0165
35–39	0.1079	0.0063	0.0106	0.0758	0.0397	0.0195	0.0261	0.2346	0.0206
40–44	0.1072	0.0063	0.0146	0.0751	0.0403	0.0245	0.0250	0.2263	0.0276
45–49	0.1034	0.0062	0.0215	0.0775	0.0418	0.0332	0.0249	0.2294	0.0390
50–54	0.0936	0.0055	0.0321	0.0768	0.0419	0.0457	0.0262	0.2228	0.0557
55–59	0.0891	0.0051	0.0472	0.0769	0.0408	0.0627	0.0244	0.2227	0.0770
60–64	0.0845	0.0046	0.0690	0.0773	0.0393	0.0860	0.0234	0.2075	0.1040
65–69	0.0837	0.0044	0.0990	0.0773	0.0383	0.1180	0.0222	0.1949	0.1382
70–74	0.0742	0.0042	0.1422	0.0770	0.0382	0.1618	0.0237	0.1973	0.1828
75–79	0.0762	0.0037	0.2034	0.0780	0.0367	0.2226	0.0236	0.1851	0.2379
80+	0	0	1	0	0	1	0	0	1

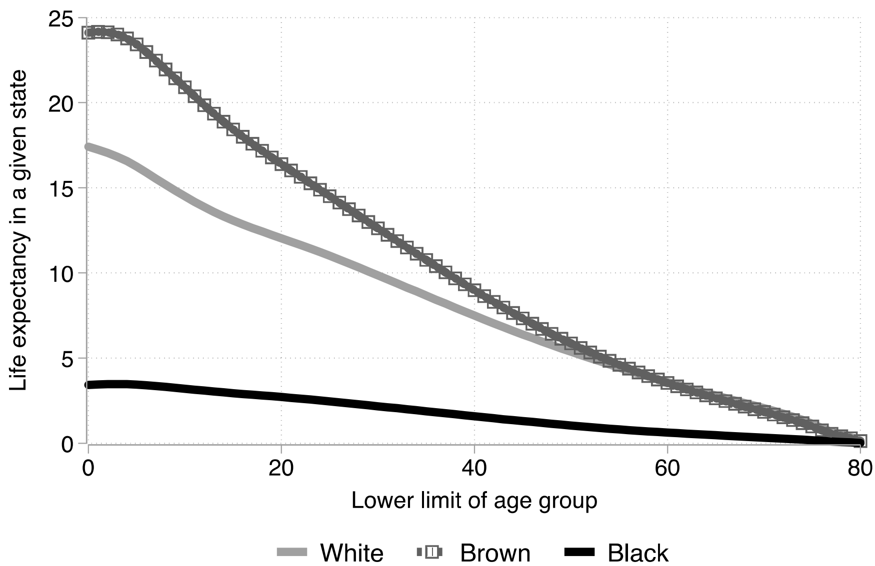
Notes: W = White; Br = Brown; B = Black; D = death. Race-specific probabilities of dying are based on data (qx) from Table 1.
Source: Racial classification transitions are based on data from the 2017–2019 PNAD-C, available at: https://github.com/blanza/race_multistate.

Table 2 reveals several patterns in the transition probabilities for racial classification derived from the 2017–2019 PNAD data. Overall, the least stability is observed for classification as Black. Brazilians older than 65 years have the highest classification stability as White, while classification stability as Brown is highest among Brazilians younger than 15 years old. The most common classification transition is from Black to Brown, with an average probability of 23%. The least frequent transition is from White to Black, with a probability on the order of 0.5%. The likelihood of transitioning from White to Brown and Black to Brown decreases with age, while the probability of transitioning from Brown to Black increases until age 54. These racial reclassification patterns derive from several factors, including the recent “darkening” among Brazilians with higher socioeconomic status (Daniel and Hernández 2020; De Micheli 2021; Marteleto 2012; Miranda 2015; Telles and Paschel 2014) – as well as specific incentives to reclassify into the Brown or Black categories related to recent affirmative action policies in universities and the labor market (Francis and Tannuri-Pianto 2012, 2013; Francis-Tan and Tannuri-Pianto 2015; Schwartzman 2009).

Table 2 also shows that on average, until age 65, Brazilians have higher probabilities of changing classification from White to Brown or from Black to Brown at any age than their probability of dying. In contrast, Brazilians who were classified as White at birth or in their first year of life have higher probabilities of infant mortality than probabilities of being reclassified as Black. This comparison underscores both the relative frequency of racial fluidity in Brazil and that some category transitions are more common than others.

Using these data as inputs for the multistate Stata program (Muniz 2020), we obtain unconditional life expectancies by age and racial classification (see Figure 1).

Figure 1: Population-based (unconditional) life expectancy at age *x* by racial classification



Note: Unconditional life expectancy equals the number of years to be lived in state *i* after age *x*. Unconditional life expectancies combine the experience of cohorts born in all states. Estimates were computed using `mslt`, a Stata program developed by Muniz (2020).
Source: Same as Tables 1 and 2.

We also calculate summary measures by state (see Table 3), and to obtain the predicted number of years that those in state *i* at exact age *x* will live in state *j*, we compute conditional life expectancies (see Table 4).

Table 3: Summary multistate measures

	State *i*			
	White	Brown	Black	Death
Proportion of life spent in state *i*	0.2177	0.3014	0.0428	0.4381
Probability of dying in state *i*	0.3279	0.5708	0.1012	-
Average duration of state *i*	8.8490	8.2355	3.4473	-
Mean age of persons in state *i*	27.4723	26.6014	30.0400	56.4165

Note: Unconditional estimates were computed using `mslt`, a Stata program developed by Muniz (2020).
Source: Same as Tables 1 and 2.

Table 3 shows that on average, given current patterns of racial classification and fluidity, Brazilians will spend about one-fifth of their lives classified as White, 30% as Brown, and 4% as Black. Alternatively, we estimate that a cohort will live about nine years classified as White, eight years as Brown, and three years as Black regardless of racial classification at birth.

Table 4: Status-based (conditional) life expectancies at birth by origin state

State of origin (at age 0)	Expected number of years to be lived in each state		
	White	Brown	Black
White	19.3389	22.7693	3.2086
Brown	15.1736	25.8218	3.4402
Black	14.7757	24.5590	6.0125

Note: Conditional life expectancy is the lived experience of a single cohort born at a given age and in just one state. Calculations include death as an absorbing state and the following number of births, according to Table 1: l_0^{White} = 1,057,855; l_0^{Brown} = 809,087; l_0^{Black} = 81,067. Estimates were computed using the Stata program developed by Muniz (2020).
Source: Same as Tables 1 and 2.

Conditional life expectancies in Table 4 show that individuals tend to spend most of their years classified as Brown regardless of how they were classified at birth. Taken together, the results offer a series of benchmarks for the extent of racial fluidity in contemporary Brazil that can be used in future comparative research.

4. Conclusion

Previous research in the United States has used inconsistent racial classification on birth and death certificates to highlight the fluidity, or unreliability, of racial data (e.g., Hahn, Mulinare, and Teutsch 1992). Here we show that even if someone’s racial classification is consistent at birth and death, we should not assume that their race remained consistent every year in between. In line with both theory and a growing body of empirical research, increment-decrement life tables allow us to better account for race as a changing propensity rather than a fixed state. Acknowledging the potential for racial fluidity is an important part of understanding the consequences of racial classification in contexts of racial inequality, such as Brazil.

The multistate life tables also open up possibilities for measuring temporal and regional variations in racial fluidity and stability. First, by looking at how these propensities to reclassify from one race to another have shifted over time, one could get an indication of whether age patterns of fluidity might differ or whether racial boundaries are becoming more (or less) permeable in general. Second, examining variations in multistate life tables by race across space would offer unique evidence of where boundary crossing was more (or less) common, either within the same country (Muniz and Bastos 2017; Pickett, Saperstein, and Penner 2019) or between countries.

Future research should incorporate these two dimensions, time and space, into multistate estimates, not only to measure racial fluidity over the life course but also to understand the dynamics of related social processes, such as incarceration, the life cycle dynamics of political and religious affiliation, income mobility, and poverty status (Schoen 2020). The application of multistate life tables can also be extended to control for covariates of interest in the estimation of transition probabilities (e.g., socioeconomic status), adjust for complex survey designs (Mehri 2022), and incorporate heterogeneity and sampling uncertainty (Lynch and Brown 2005, 2010). Our illustration here is relatively simple but demonstrates the potential of seeing race – and racial classification – not as a fixed state but as a mutable attribute over the life cycle and beyond.

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