

WEB MATERIAL

Title: Age, period, and cohort effects of internalizing symptoms among US students and the influence of self-reported frequency of ≥ 7 hours sleep attainment: Results from the Monitoring the Future Survey 1991-2019

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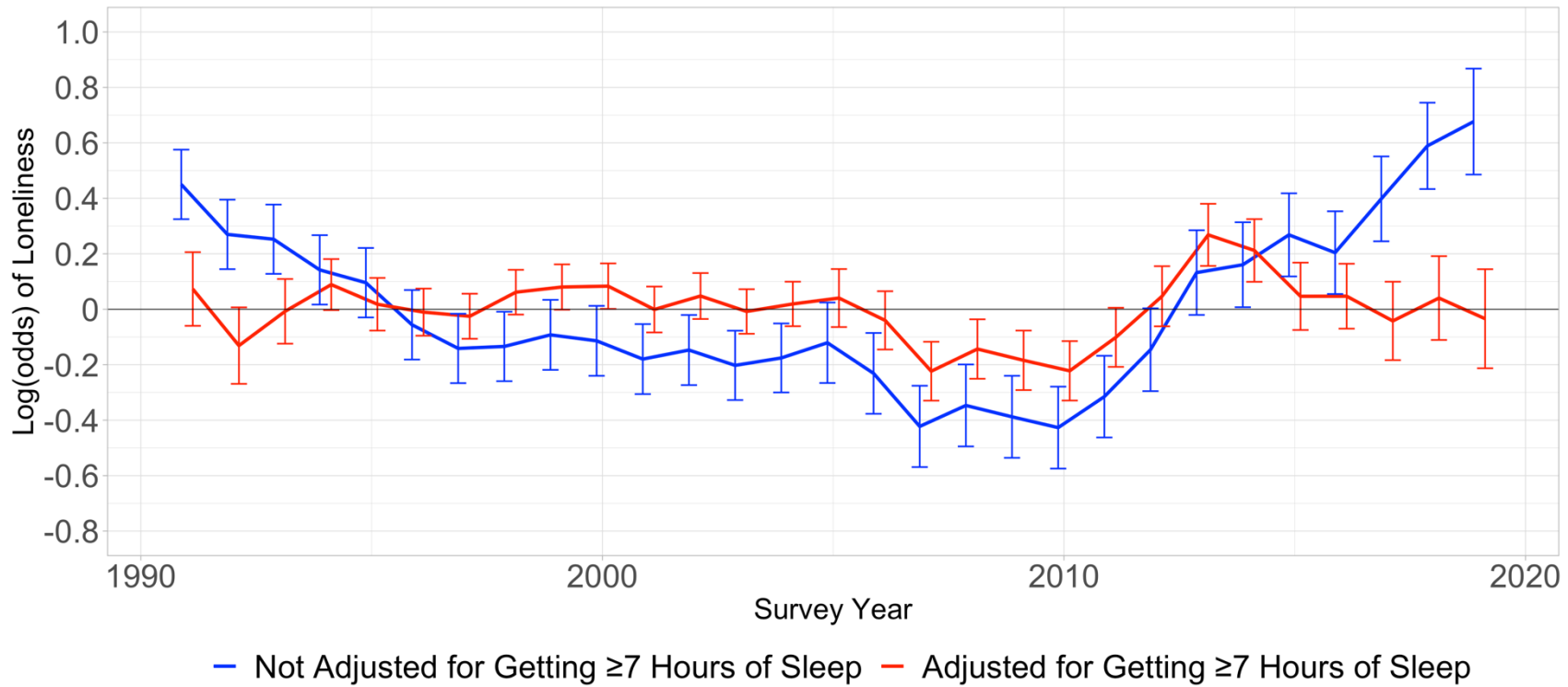
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Web Table 1. Comparison of students who were include or excluded from the full-sample loneliness AP model by sociodemographics^a

		Excluded		Included	
		N	Row %	N	Row %
Sex	Male	70,478	39.28	108,926	60.72
	Female	67,581	35.95	120,420	64.05
	Missing	14,034			
Past-year drinking	Yes	69,601	36.48	121,167	63.52
	No	58,403	35.06	108,179	64.94
	Missing	24,089			
Past-year cannabis use	Yes	32,639	38.66	51,795	61.34
	No	107,981	37.82	177,551	62.18
	Missing	11,473			
Past-year other substance use	Yes	9,875	23.52	32,104	76.48
	No	71,106	26.50	197,242	73.50
	Missing	71,112			
GPA	B- or less	55,842	41.27	79,475	58.73
	B or greater	81,293	35.17	149,871	64.83
	Missing	14,958			
Age	10-11	103	57.22	77	42.78
	12-13	21,722	31.83	46,519	68.17
	14-15	43,238	28.23	109,943	71.77
	16-17	43,909	39.52	67,189	60.48
	18+	32,498	85.26	5,618	14.74
	Missing	8,300			
Race	Black	24,931	51.00	23,953	49.00
	White	68,389	30.65	154,761	69.35
	Hispanic	22,602	48.47	24,029	51.53
	Other	17,871	40.18	26,603	59.82
	Missing	18,300			
Parental education	Neither parent completed college	62,053	37.68	102,629	62.32
	At least one parent completed college	59,008	31.77	126,717	68.23
	Missing	31,032			

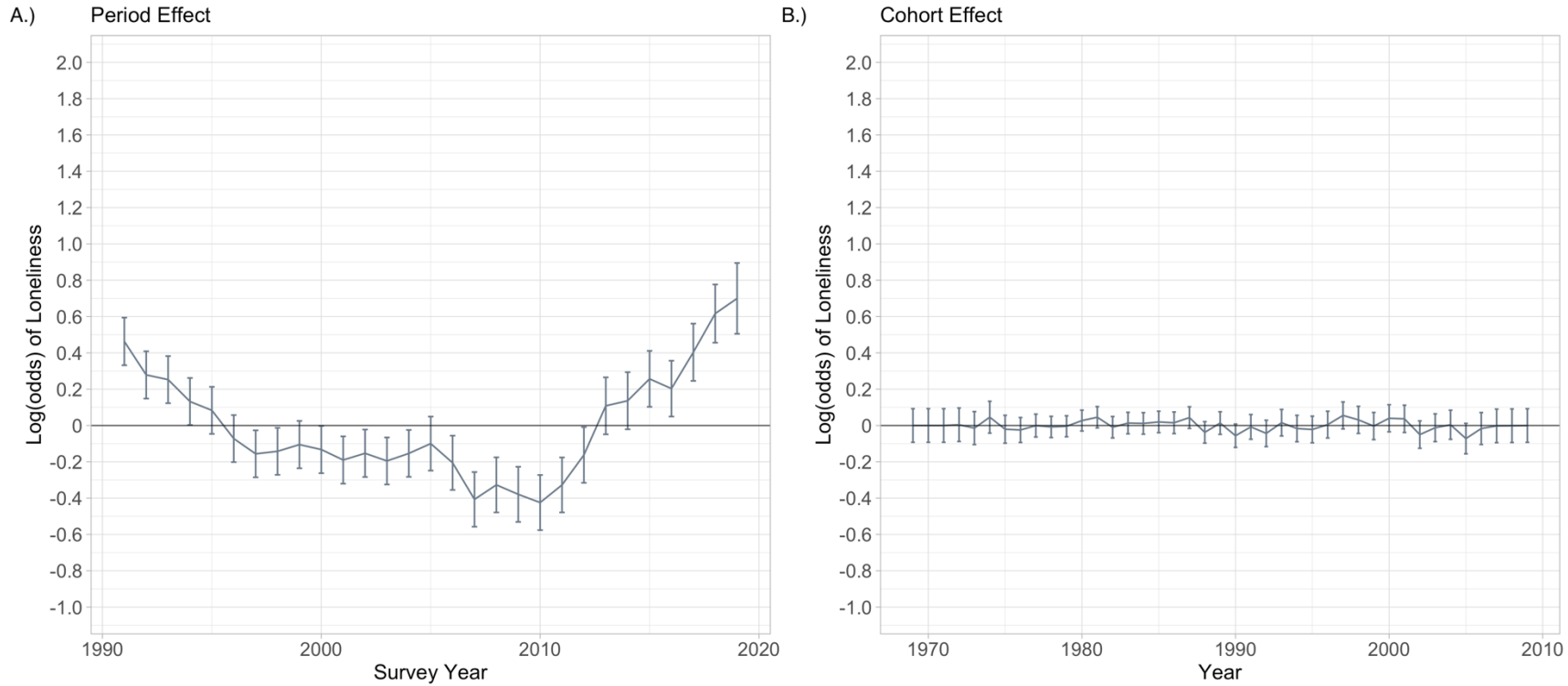
^aNote: A total of 381,439 students participated in the study from 1991-2019 and were randomly assigned to the survey sub-forms containing questions about loneliness. However, due to data missingness the sample for the full-sample loneliness AP model was 229,346.

Web Figure 1. Hierarchical age-period estimates of period effects of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019), with and without adjusting for self-reported frequency of attaining ≥ 7 hours of sleep most days/nearly every day/every day^a



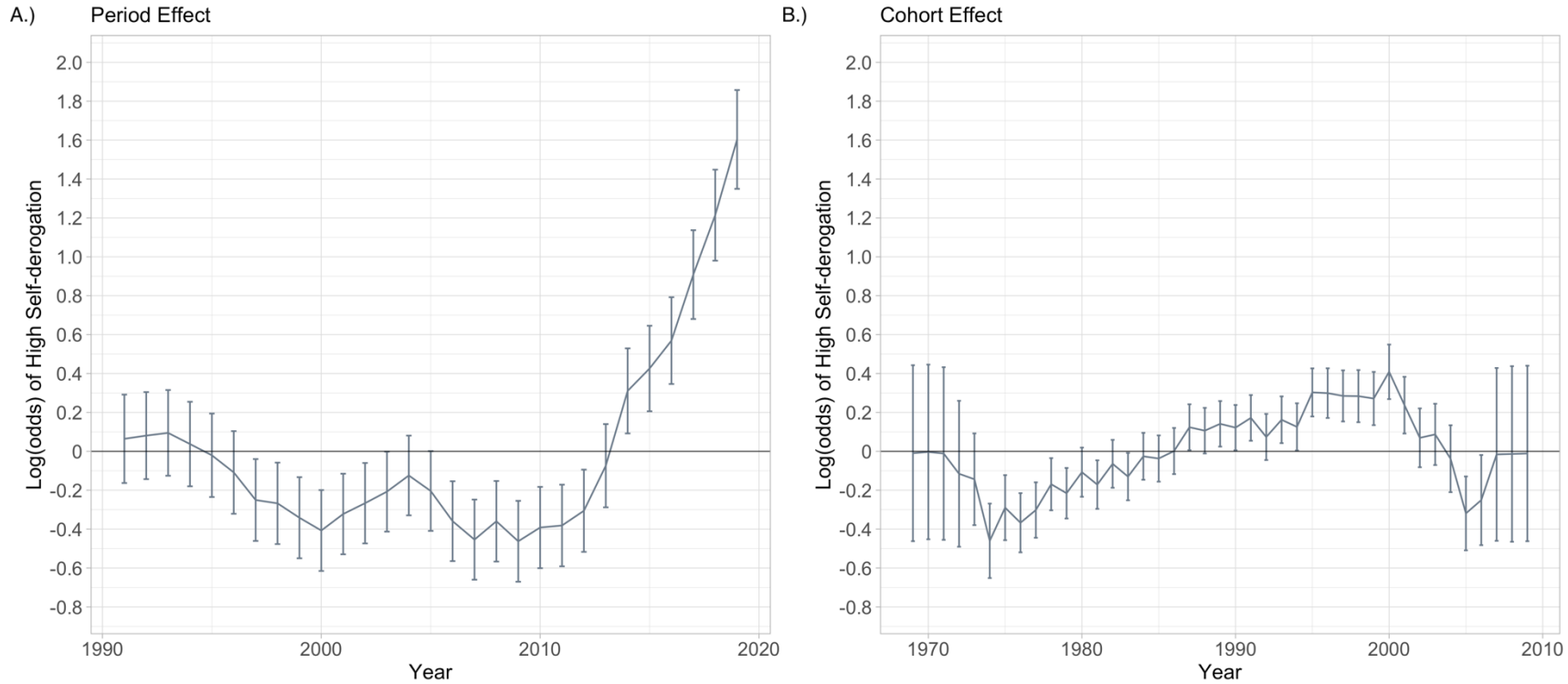
^aNote: Models also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=229,346)

Web Figure 2. Hierarchical age-period-cohort estimates of period and cohort effects of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019). A.) Period Effect; B.) Cohort Effect^a



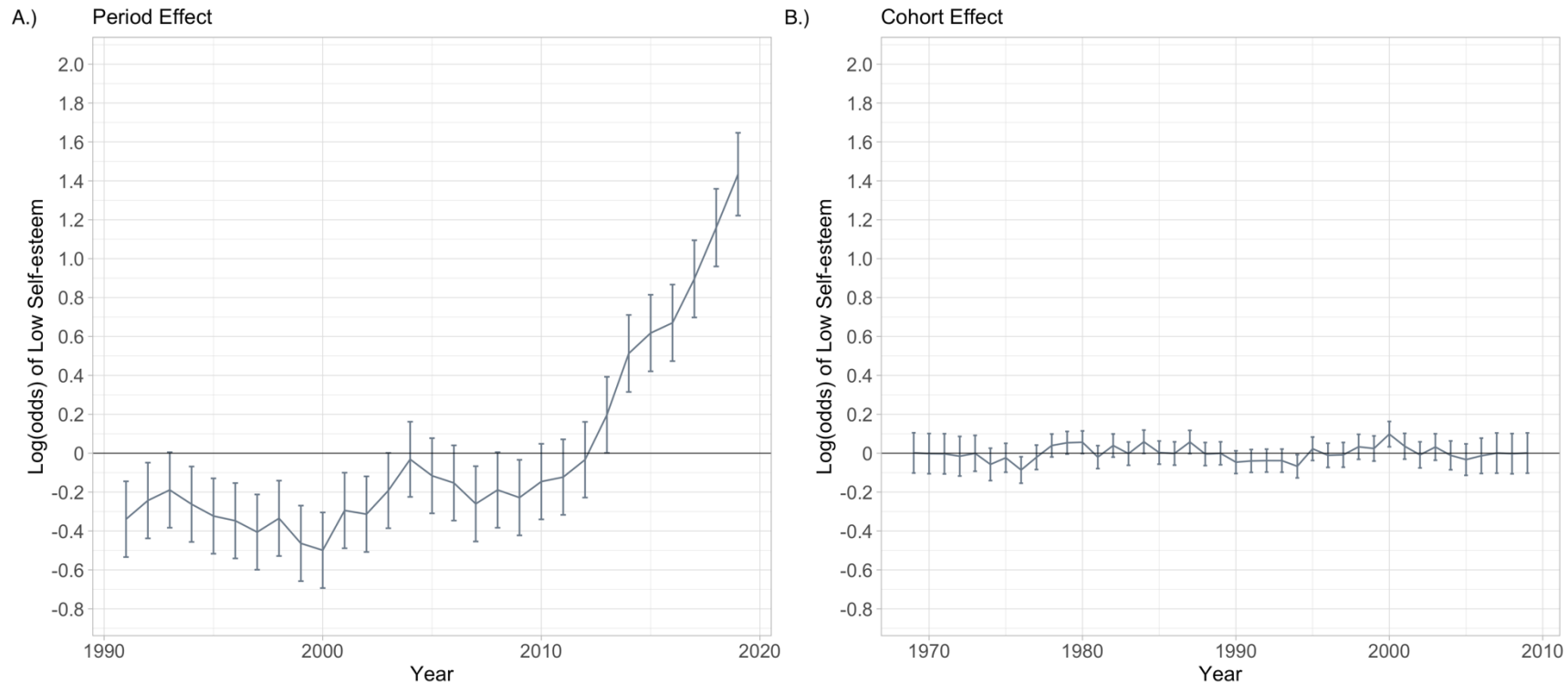
^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=229,346)

Web Figure 3. Hierarchical age-period-cohort estimates of period and cohort effects of high self-derogation among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019). A.) Period Effect; B.) Cohort Effect^a



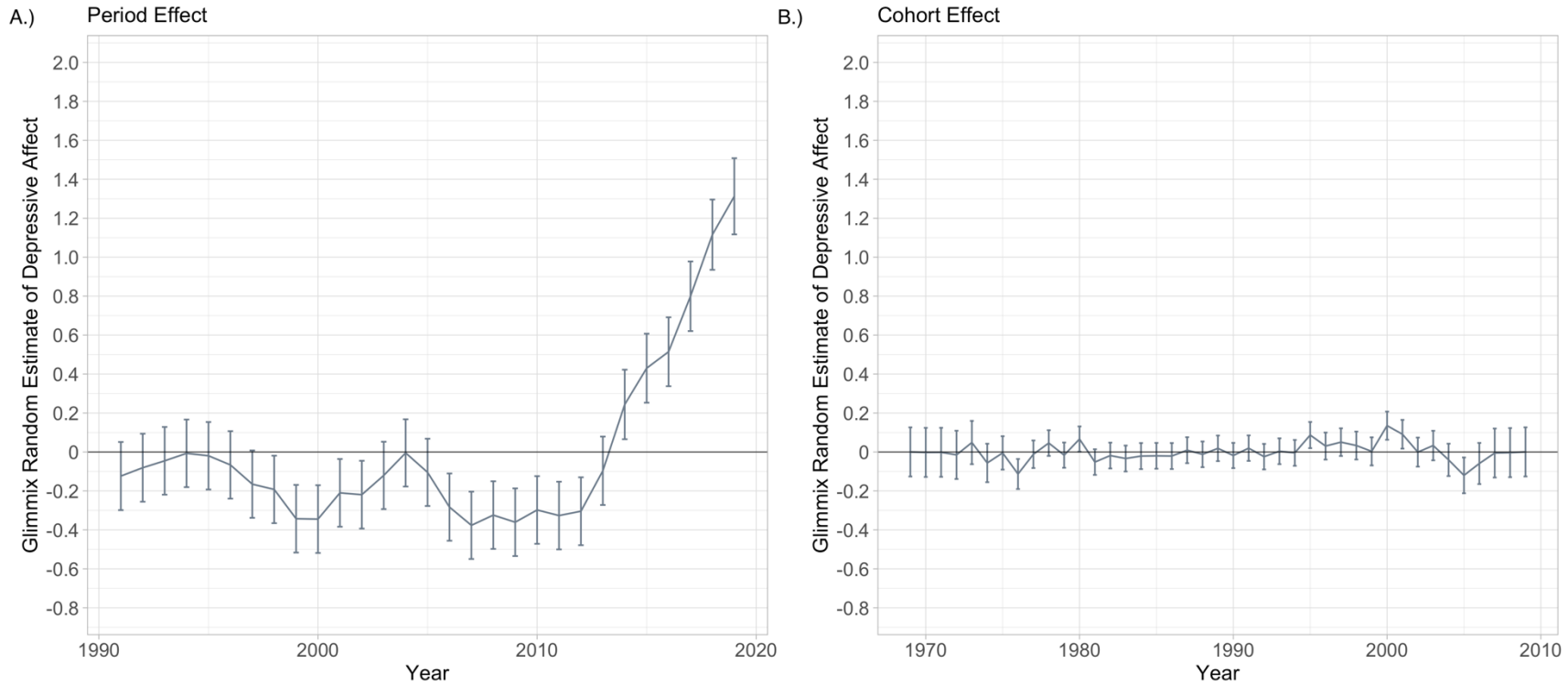
^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=387,718)

Web Figure 4. Hierarchical age-period-cohort estimates of period and cohort effects of low self-esteem among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019). A.) Period Effect; B.) Cohort Effect^a



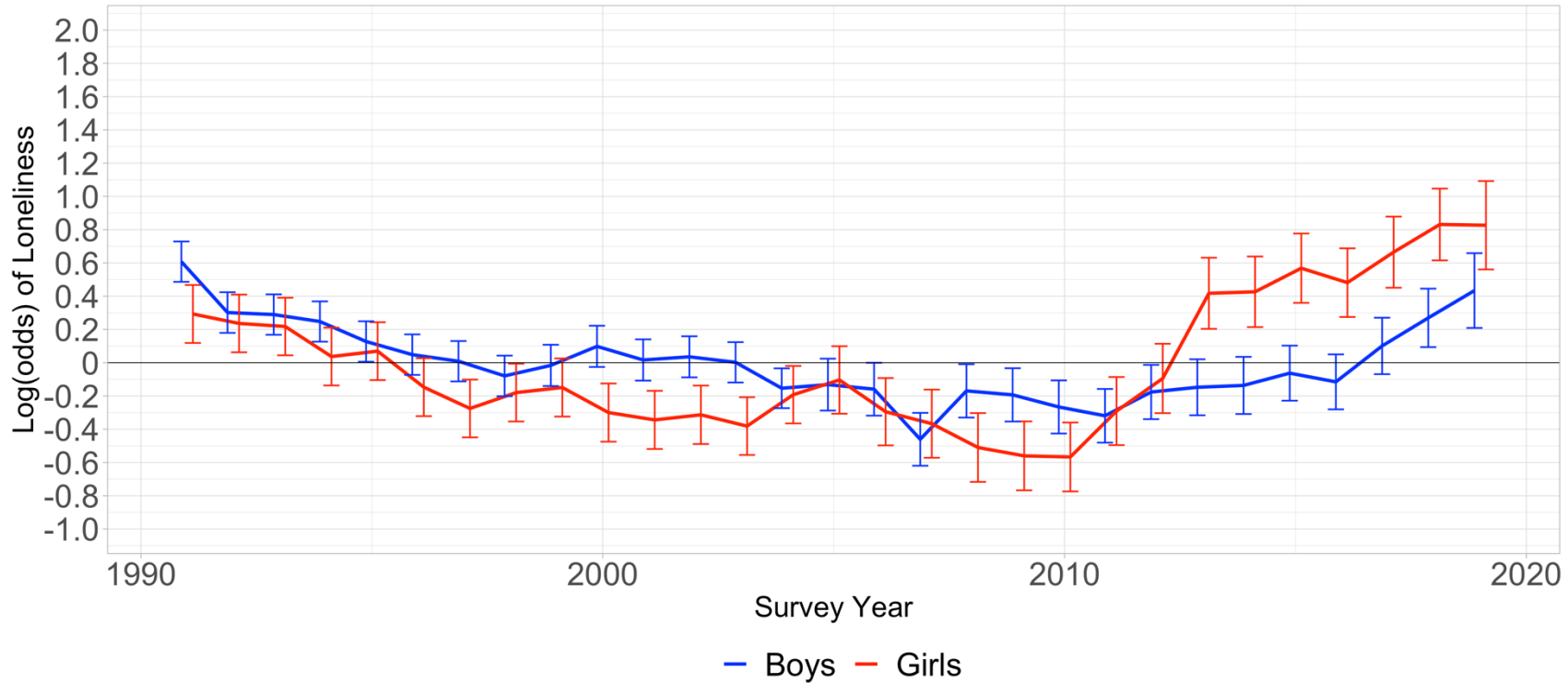
^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=389,443)

Web Figure 5. Hierarchical age-period-cohort estimates of period and cohort effects of depressive affect among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019). A.) Period Effect; B.) Cohort Effect^a



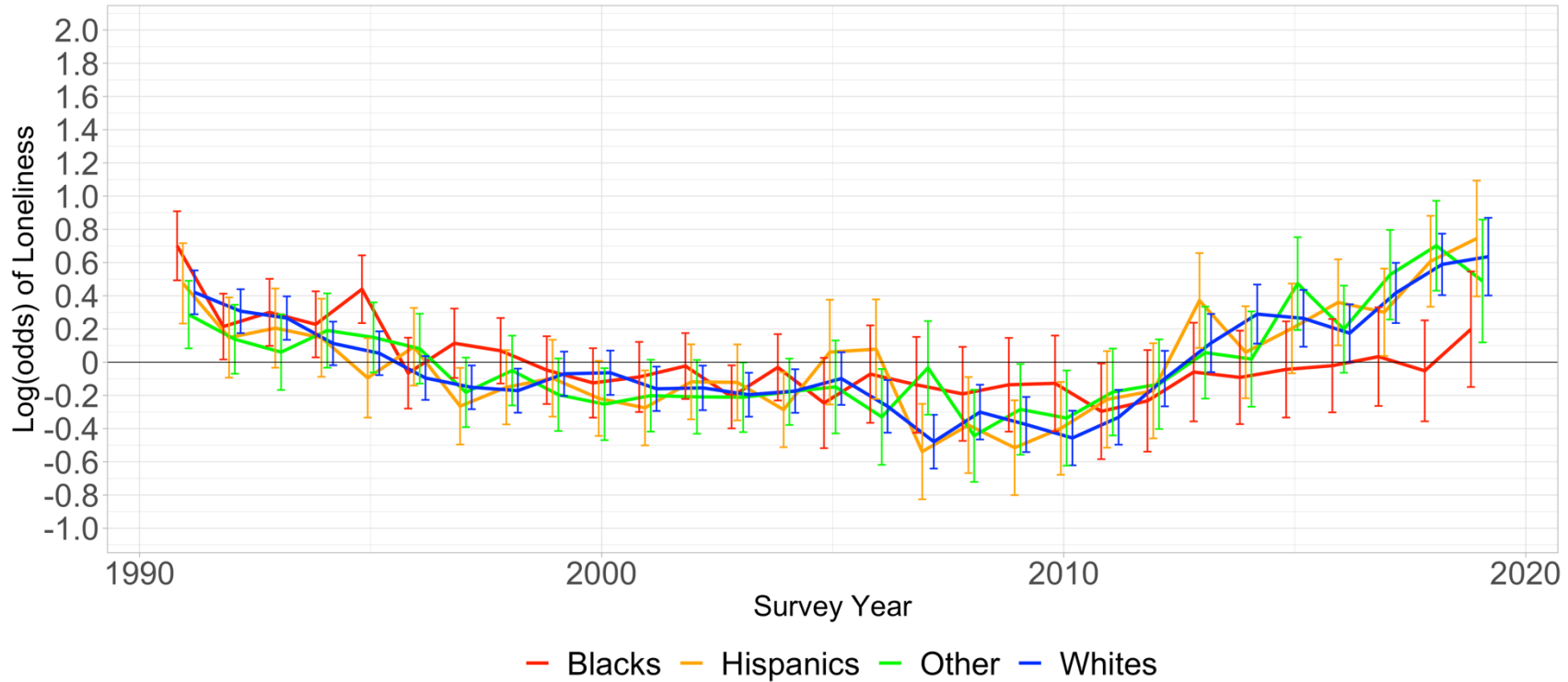
^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=370,570)

Web Figure 6. Hierarchical age-period estimates by sex of period effects of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019)^a



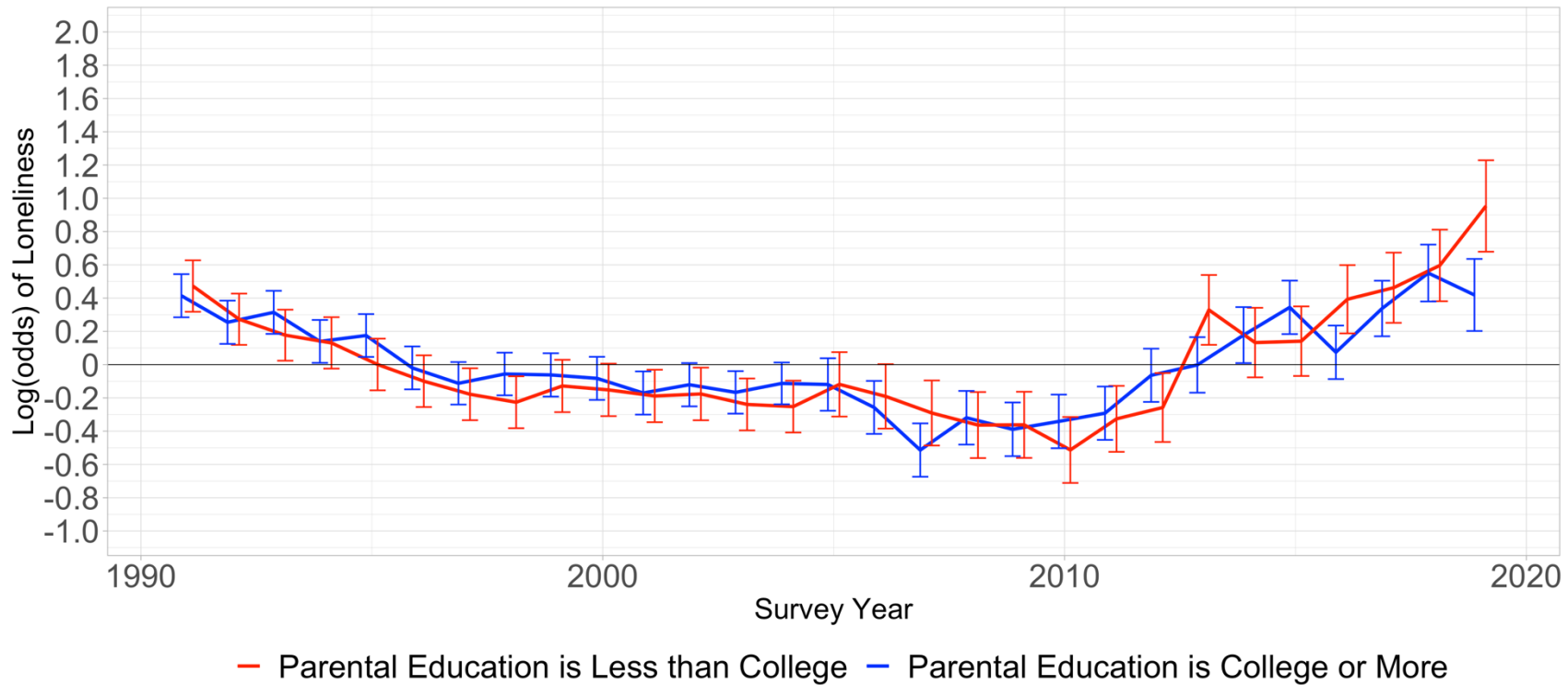
^aNote: Model also adjusted for race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=120,420 for girls, N=108,926 for boys)

Web Figure 7. Hierarchical age-period estimates by race/ethnicity of period effects of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019)^a



^aNote: Model also adjusted for sex (male vs. female), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=23,953 for Blacks, N=154,761 for Whites, N=24,029 for Hispanics, N=26,603 for other)

Web Figure 8. Hierarchical age-period estimates by parental education of period effects of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019)^a



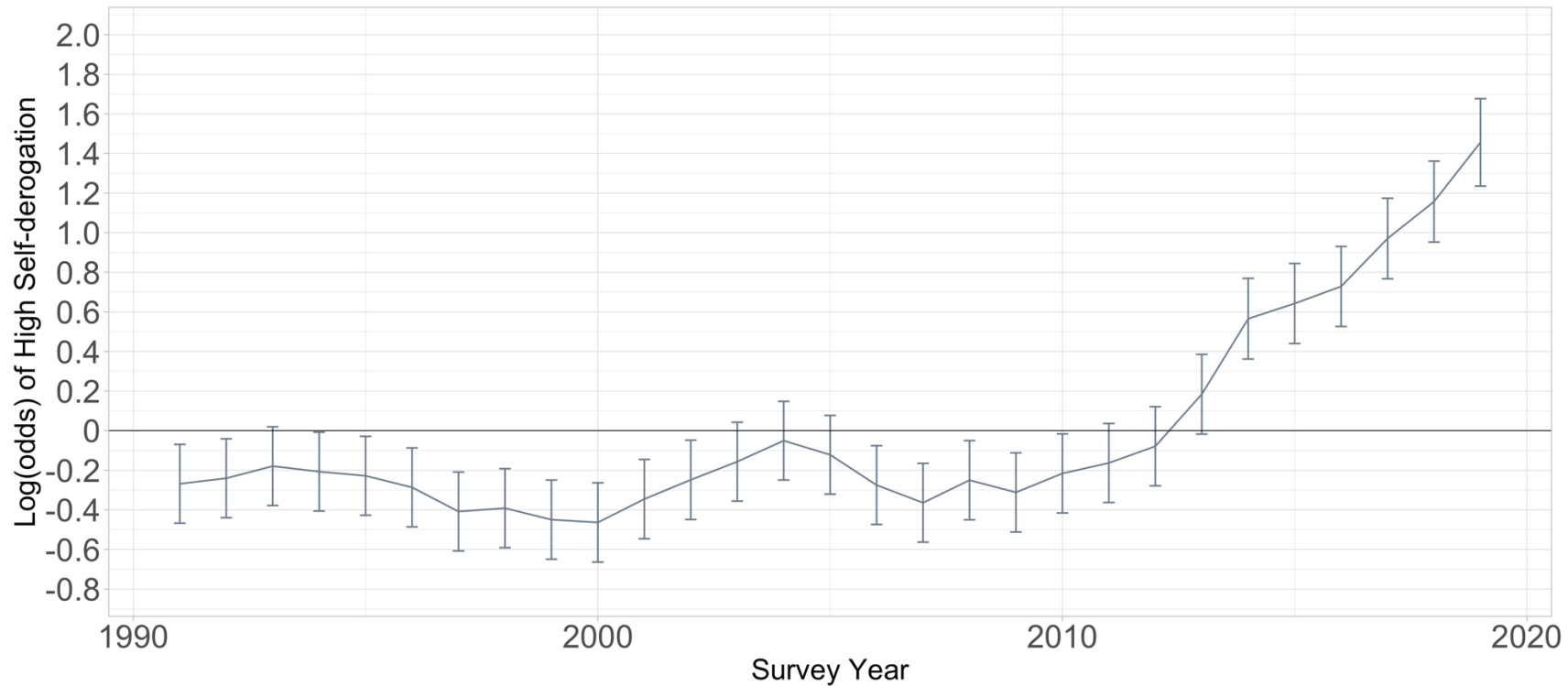
^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=102,629 for parental education is less than college, N=126,717 for parental education is college or more)

Web Table 2. Multinomial Logistic Regression of Loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019), adjusting for race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), past-year cannabis/alcohol/other drug use, and the interaction between survey year and sex^a

Covariate	Parameter Estimate	(95% CI)
Two-year Age Group (Ref=14-15)		
10-11	-0.017	(-0.115, 0.08)
12-13	-0.017	(-0.021, -0.012)
16-17	0.02	(0.016, 0.024)
18+	0.095	(0.084, 0.106)
Past-year Alcohol Use (Ref=No)		
Yes	0.015	(0.01, 0.019)
Past-year Cannabis Use (Ref=No)		
Yes	-0.037	(-0.042, -0.031)
Past-year Other Drug Use (Ref=No)		
Yes	0.055	(0.049, 0.061)
GPA (Ref=B- or Less)		
B or Greater	-0.036	(-0.04, -0.032)
Sex (Ref=Male)		
Female	0.127	(0.123, 0.131)
Survey Year	-0.002	(-0.003, -0.002)
Survey Year * Sex (Ref=Male)	0.003	(0.002, 0.003)
Parental Education (Ref=Maximum Parental Education is Not College)		
Parental Education is College or More	-0.021	(-0.025, -0.018)
Race/Ethnicity (Ref=White)		
Black	0.011	(0.005, 0.017)
Hispanic	-0.003	(-0.009, 0.003)
Other	0.046	(0.041, 0.052)
Survey Mode (Ref=Paper)		
Tablet	0.061	(0.042, 0.079)

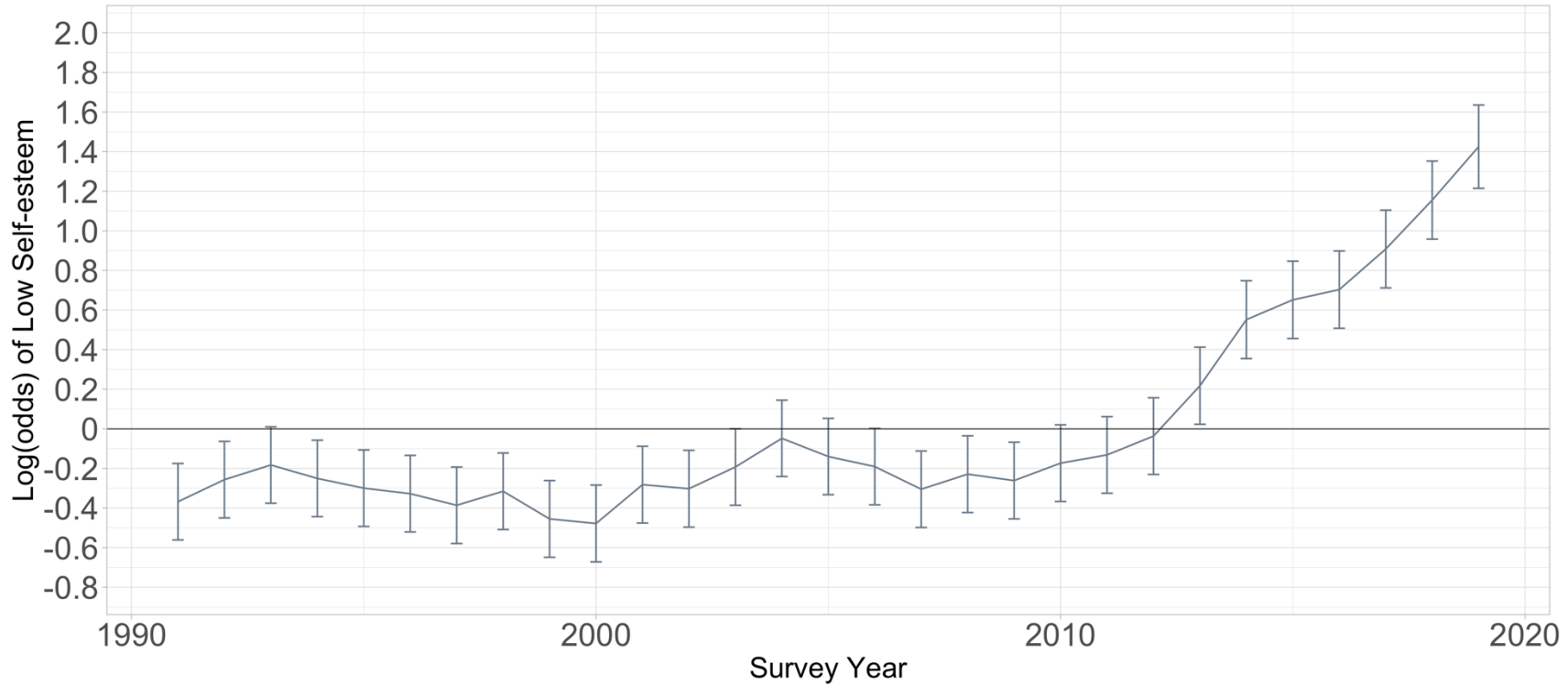
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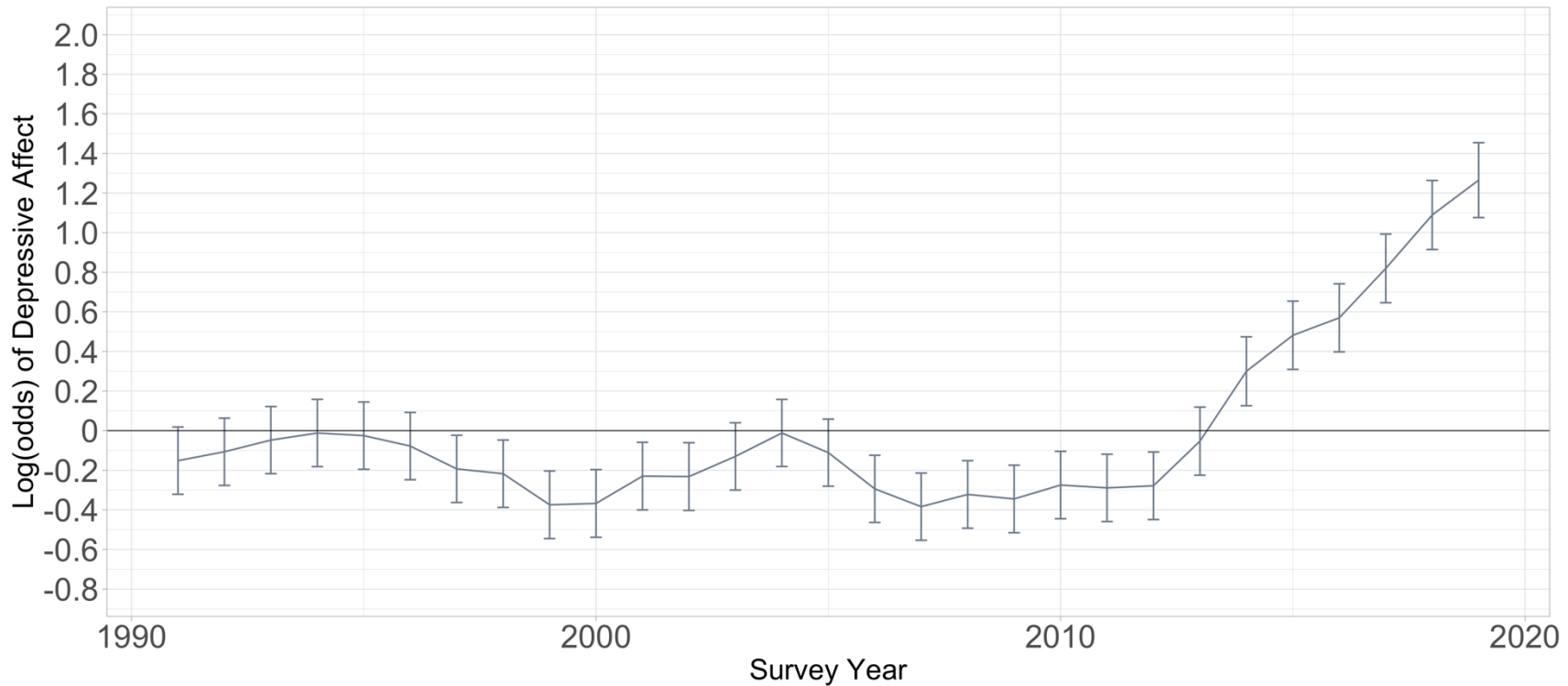
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Web Figure 10. Hierarchical age-period estimates of period effects of low self-esteem among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019)^a



^aNote: Model also adjusted for sex (male vs. female), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, other), parental education (either parent had some college or less vs. completed college or more, as reported by the adolescent), GPA (B- or less vs. B or higher), survey implementation technique (paper vs. tablet), and past-year cannabis/alcohol/other drug use. Drugs in the “other substance use” category vary by grade: for 12th graders we include LSD, other hallucinogens, cocaine, amphetamines, sedatives, tranquilizers, heroin, narcotics, crack, and other forms of cocaine. For 8th and 10th graders we do not include heroin, narcotics, or sedatives. (N=389,443)

Web Figure 11. Hierarchical age-period estimates of period effects of depressive affect among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019)^a



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Web Figure 12. Sensitivity analysis of age-period-cohort estimates of loneliness among 8th, 10th, and 12th graders in the Monitoring the Future Study (1991-2019) using the intrinsic estimator. A.) Age, years; B.) Survey Year; C.) Birth Cohort Year (N=324,179)

