

Appendix A. Sensitivity analyses for nonlinear strain effects models

Bivariate Models (see note 9)

1. Fractional polynomial models for each outcome.

Table 2a. Fractional polynomial models of stressful life events, delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Delinquent & young adult criminal behavior		Depressive symptoms	
	linear	nonlinear	linear	nonlinear
Stress	2.10** (0.13)	2.24** (0.15)	18.43** (1.83)	15.48** (1.97)
Stress ²		1.27** (0.39)		-6.94 (1.47)
R ²	0.05	0.09	0.08	0.12
AIC	22,997	22,891	44,455	44,433

Note: The cells provide unstandardized coefficients, with standard errors in parentheses. To ensure that transformations of the outcome variables did not unduly affect the potential nonlinearities, each was entered into the model in its original metric. The results merely provide the general nonlinear association between stressful life events and the two outcomes. The longitudinal nature of the data is not yet considered, although the standard errors are adjusted for clustering within individuals. The sample size is 840.

* $p < 0.05$

** $p < 0.01$

2. Nonlinear seemingly unrelated regression (SUR) model

Table 2b. Seemingly unrelated regression (SUR) models of stressful life events, delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Delinquent & young adult criminal behavior		Depressive symptoms	
	linear	nonlinear	linear	nonlinear
Stress ^a	0.28** (0.03)	0.25** (0.03)	2.52** (0.16)	2.91** (0.20)
Stress ²		0.07** (0.01)		-0.27** (0.08)
R ²	0.04	0.07	0.05	0.08
AIC	57,279	57,168	57,279	57,168
Residual correlation	0.24	0.21	0.24	0.21

Note: The cells provide unstandardized coefficients, with standard errors in parentheses. To ensure that transformations of the outcome variables did not unduly affect the potential nonlinearities, each was entered into the model in its original metric. However, the measure of stressful life events was standardized to reduce the likelihood of collinearity with its quadratic term. The results merely provide the general nonlinear association between stressful life events and the two outcomes. The longitudinal nature of the data is not yet considered, although the standard errors are adjusted for clustering within individuals. The sample size is 840.

^aMeasured in z-scores.

* $p < 0.05$

** $p < 0.01$

Multivariate models (see Sensitivity analyses section)

1. Logistic response model (binomial regression)

Table 3a. Multivariate multilevel logistic response model of stressful life events, delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Outcome variable	
	Delinquent & young adult criminal behavior	Depressive symptoms
Intercept	-0.100 (0.209)	3.384** (0.265)
Year	-0.095 (0.055)	0.332** (0.090)
Stressful life events	0.084* (0.039)	0.176* (0.075)
Stressful life events ²	0.011 (0.009)	-0.006 (0.025)
Stressful life events × year	-0.025 (0.014)	-0.047** (0.018)
Stressful life events ² × year	0.002 (0.003)	-0.004 (0.006)
Family relations	-0.194** (0.056)	-0.166** (0.036)
Stressful life events × family relations	0.050** (0.015)	0.138* (0.064)
Stressful life events ² × family relations	-0.026* (0.012)	-0.022* (0.008)
Age	0.021 (0.014)	-0.151* (0.071)
Age ²	-0.059** (0.006)	0.038** (0.011)
Random effects		
var(intercept)	2.059 (0.216)	1.935 (0.398)
var(year)	1.675 (0.531)	1.293 (0.293)
Residuals		
sd(ϵ_1)		0.30
sd(ϵ_2)		0.29
correlation($\sigma_{\epsilon_1, \epsilon_2}$)		0.22**
AIC		7,583

Note: Only the model 2 (full model) results are provided (cf. Table 3). The effects of the control variables are omitted. The coefficients are log-odds with standard errors in parentheses. The model is estimated with Gauss-Hermite quadrature to approximate the likelihood (McCulloch and Neuhaus 2013). The sample size is 840, with eight observations per individual.

* $p < 0.05$

** $p < 0.01$

2. The delinquency/criminal behavior variable is not logged

Table 3b. Multivariate multilevel regression model of stressful life events, delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Outcome variable	
	Delinquent & young adult criminal behavior	Depressive symptoms
Intercept	0.333** (0.066)	0.219** (0.065)
Year	-0.024 (0.019)	-0.009 (0.018)
Stressful life events	0.027* (0.012)	0.040** (0.012)
Stressful life events ²	0.004 (0.003)	-0.011 (0.010)
Stressful life events × year	-0.013 (0.008)	-0.017** (0.006)
Stressful life events ² × year	0.001 (0.002)	-0.003 (0.002)
Family relations	-0.053** (0.018)	-0.068** (0.017)
Stressful life events × family relations	0.070** (0.017)	-0.020 (0.015)
Stressful life events ² × family relations	-0.009* (0.003)	-0.008* (0.003)
Age	0.023 (0.017)	-0.007 (0.017)
Age ²	-0.032** (0.004)	0.002 (0.002)
Random effects		
var(intercept)	0.338 (0.022)	0.291 (0.022)
var(year)	0.012 (0.002)	0.009 (0.001)
Residuals		
sd(ε_1)		0.71
sd(ε_2)		0.73
correlation($\sigma_{\varepsilon_1, \varepsilon_2}$)		0.20**
AIC	24,482	

Note: Only the model 2 (full model) results are provided (cf. Table 3). The effects of the control variables are omitted. The sample size is 840, with eight observations per individual.

* $p < 0.05$

** $p < 0.01$

3. Multivariate fractional polynomial models

Table 3c. Multivariate fractional polynomial model of stressful life events, delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Outcome variable	
	Delinquent & young adult criminal behavior	Depressive symptoms
Intercept	1.252** (0.060)	2.318** (0.052)
Year	-0.028 (0.040)	0.010 (0.026)
Stressful life events 1	0.133** (0.023)	3.46** (0.199)
Stressful life events 2	0.086* (0.040)	-0.511 (0.353)
Stressful life events × year	-0.008 (0.008)	-0.040* (0.016)
Family relations	-0.311** (0.042)	-0.840** (0.042)
Stressful life events × family relations 1	0.067* (0.026)	-0.213 (0.127)
Stressful life events × family relations 2	-0.044* (0.016)	-0.013* (0.005)
Age 1	0.525** (0.082)	-0.088** (0.033)
Age 2	-0.405** (0.057)	0.029* (0.014)
Degrees of freedom ^a		
Year	1	1
Stressful life events	2	1
Stressful live events × year	1	1
Family relations	1	1
Stressful life events × family relations	2	2
Age	2	2
AIC	47,950	

Note: Only the model 2 (full model) results are provided (cf. Table 3). The effects of the control variables are omitted. The sample size is 840, with eight observations per individual.

^aThe degrees of freedom correspond to the number of “knots” estimated from the nonlinear associations between the explanatory variables and the outcome variables. For example, df=2 suggests one bend or knot in the association; this corresponds roughly to a quadratic association.

* $p < 0.05$

** $p < 0.01$

4. Categorical stressful life events variable

Table 3d. Multivariate multilevel model of stressful life events (categorical), delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

	Outcome variable	
	Delinquent & young adult criminal behavior	Depressive symptoms
Intercept	0.302** (0.025)	0.095 (0.255)
Year	-0.827 (0.064)	0.052 (0.063)
Stressful life events ^a		
1-2	0.008 (0.008)	0.015 (0.016)
3-4	0.025* (0.010)	0.046* (0.019)
5 or more	0.077** (0.012)	0.082** (0.025)
Stressful life events ^a × year		
1-2	-0.013 (0.017)	-0.015 (0.018)
3-4	-0.034 (0.019)	-0.046* (0.019)
5 or more	-0.088** (0.024)	-0.082** (0.025)
Family relations	-0.057* (0.031)	-0.027* (0.036)
Stressful life events ^a × family relations		
1-2	0.097 (0.088)	0.028 (0.033)
3-4	0.099 (0.139)	-0.022 (0.024)
5 or more	-0.308* (0.151)	-0.199** (0.050)
Age	0.011 (0.019)	-0.007 (0.009)
Age ²	-0.025** (0.002)	-0.096 (0.055)
Random effects		
var(intercept)	0.206 (0.022)	0.194 (0.039)
var(year)	0.167 (0.053)	0.129 (0.029)
Residuals		
sd(ε_1)		0.74
sd(ε_2)		0.75
correlation($\sigma_{\varepsilon_1, \varepsilon_2}$)		0.24**

Table 3d. Multivariate multilevel model of stressful life events (categorical), delinquent and young adult criminal behavior, and depressive symptoms, Family Health Study, 1993 – 2001

AIC	24,296
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Note: Only the model 2 (full model) results are provided (cf. Table 3). The effects of the control variables are omitted. The sample size is 840, with eight observations per individual.

^aZero stressful life events is the comparison group.

* $p < 0.05$

** $p < 0.01$