

1 Early adversity, adult lifestyle, and posttraumatic stress disorder in a military sample

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22 Early adversity is considered a major risk factor for adult PTSD. Simultaneously, however, early

23 adversity is also known to contribute to psychological resilience, and, indeed, some high-

24 adversity groups do not display elevated PTSD risk. We explored correlates of PTSD in the

25 STARRS military data set to evaluate contrasting accounts of the relationship between early

26 adversity and PTSD. The standard deficit model depicts ontogeny as inherently vulnerable to

27 insult, such that early adversity yields a less robust adult phenotype. A complementary life

28 history theory account holds that adverse early experiences cue a fast life history orientation that

29 reduces investment in maintenance, yielding an adult phenotype less able to recover from

30 trauma. An opposing life history theory account holds that early adversity cues expectations of

31 an adverse adult environment, adaptively reducing reactivity to adverse events. We use principal

32 component analysis to extract a latent variable representing several childhood experiences and

33 multiple lifestyle factors that plausibly proxy life history orientation. After correcting for

34 covariates, we find a strong positive influence of such proxies on PTSD risk, suggesting that

35 early adversity may indeed increase risk for PTSD, and thus that either the standard deficit

36 model, the reduced maintenance account, or a combination are correct.

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40

41 **Introduction**

42 Anxiety disorders are the most common mental illness in the United States. Over eight
43 million Americans suffer from Posttraumatic Stress Disorder (PTSD); 6.8% of the population
44 will develop PTSD at some time in their lives (Dückers et al., 2016). PTSD can be understood as
45 a disorder of evolved defensive reactions following exposure to trauma (Cantor, 2009). Indeed,
46 consistent with the condition's being rooted in species-typical psychology, despite some
47 variation, it occurs across widely divergent sociocultural and ecological contexts (Zefferman &
48 Mathew, 2021).

49 While trauma exposure is definitional to PTSD, there is nevertheless substantial inter-
50 individual variation in the extent to which such experiences result in the condition. According to
51 the DSM-5, pre-trauma risk factors include prior mental disorders, lower socioeconomic status,
52 childhood adversity, minority racial status, and reduced social support (American Psychiatric
53 Association, 2013). Risk is higher among females and younger adults. These individual factors
54 predisposing PTSD risk support the deficit model of PTSD wherein one's ability to emotionally
55 process a traumatic experience is debilitated by early adversity, resulting in dysregulated,
56 overactive coping mechanisms persisting beyond their usefulness and long after the initial
57 experience. This construal of adversity as cumulatively damaging or hindering an individual's
58 cognitive and emotional capacity for coping with potentially traumatic experiences is a
59 component of all major existing theories and perspectives on PTSD etiology.

60 Viewed from an evolutionary perspective, the deficit model can be understood in either
61 of two ways. First, the extent of developmental canalization may have been inherently
62 constrained. All else being equal, a developmental process robust to perturbation would seem
63 optimal. However, all else is not equal, as such robusticity may be prohibitively expensive
64 (coming, for example, at the expense of the pace of development, total number of offspring,
65 etc.). If the average payoff across individuals of robust development exceeds the cost,
66 canalization will be incomplete – in essence, selection will favor a degree of developmental
67 fragility as a price worth paying, the consequence being that adverse early experiences may set
68 the stage for multiple adult pathologies. Alternately, selection may favor developmental
69 plasticity rather than canalization. Insults during development may constitute cues regarding the
70 expected payoffs of enduring investments in maintenance.

71 Life history theory seeks to understand key aspects of the adult phenotype in terms of
72 inherent tradeoffs between growth, reproduction, and longevity. Of direct relevance here, various
73 versions of life history theory hold that adverse early experiences can indicate that, given
74 corresponding expected high adult mortality, on average fitness will be optimized by devoting
75 resources to rapid maturation and reproduction at the expense of longevity (Ellis et al., 2017;
76 Figueredo et al., 2006; Hill & Kaplan, 1999; Simpson et al., 2012; Wu et al., 2020a).
77 Considerable debate surrounds various applications of life history frameworks to individual
78 variation among contemporary humans (see Frankenhuis & Nettle, 2020; Stearns & Rodrigues,
79 2020; Wu et al., 2020a). Furthermore, observers (see Frankenhuis & Nettle, 2020; Sear, 2020)
80 have distinguished between the use of the life history framework in the measurement of features

81 directly associated with the key tradeoffs (such as morphological and physiological attributes;
82 the timing of sexual maturation and reproduction; total fertility; etc.), and the use of this
83 framework in the measurement of psychosocial features that, conceptualized as part of overall
84 strategies, are more distally related to these tradeoffs (such as personality; sociosexual
85 orientation; future discounting; cooperativeness; etc.). Critics (*ibid.*) argue that, unlike the former
86 corpus, the latter body of work is too far removed from the tradeoffs central to life history theory
87 to be informed by such considerations – and at least one study has found that, when
88 psychometric measures are directly pitted against biodemographic indices more closely linked to
89 the key tradeoffs, the former fail to predict the latter (Međedović, 2020).

90 While acknowledging the limitations of some translations of life history frameworks to
91 the psychological domain, in an attempt to better illuminate the relationship between early
92 experience and PTSD, here we suggest two applications of the life history approach which apply
93 the construct of a life history strategy while conceptually centering the key principle of tradeoffs
94 between growth, reproduction, and longevity. Deferring for the moment the details of how we
95 operationalize life history strategy, below we outline these two theoretical applications.

96 First, if a harsh early environment is treated by evolved calibration mechanisms as
97 predictive of high extrinsic mortality in adulthood, investments in rapid maturation and
98 reproduction may be privileged over investments in long-term maintenance and repair, leading to
99 a less resilient adult phenotype. This provides an ultimate explanation for the patterns posited by
100 the conventional deficit model of PTSD etiology. Individuals who experienced adverse early
101 environments will be more vulnerable to a variety of insults to fitness not because building
102 resilience was inherently precluded by deprivation, but rather because the resources necessary
103 for such resilience were instead committed to rapid growth and reproduction. If any potential
104 gains from greater durability would likely be precluded by fatal challenges against which no
105 degree of resilience would suffice, then building resilience yields lower expected payoffs than
106 accelerating reproduction.

107 The deficit model of PTSD is both intuitive and supported by a considerable corpus of
108 epidemiological findings. For example, for U.S. disaster workers who responded in the aftermath
109 of the 9/11 terrorist attacks, PTSD incidence was higher among those whose lifestyle
110 characteristics were associated with greater early adversity (Giosan & Wyka, 2009). However,
111 not all available evidence supports this model. Despite the description present in the DSM-5,
112 meta-analyses have shown that racial minority status – which, reflecting the consequences of
113 discrimination, is frequently associated with adverse early experiences – is a weak or absent
114 predictor (Bonanno et al., 2007; Roberts et al., 2011). Moreover, research into psychological
115 resilience has demonstrated that, under certain circumstances, adversity is critical to developing
116 resilience (Luthar, 2006). Within the U.S. military, reserve forces – who, being more educated
117 and enjoying higher socioeconomic status, can be presumed to have suffered fewer adverse early
118 experiences – sometimes have similar or higher PTSD rates compared to active-duty troops
119 (Lane et al., 2012; Milliken et al., 2007). Lastly, a recent study of PTSD in 24 nations found that
120 measures of adversity such as malnutrition, income inequality, and access to sanitation were

121 negatively, not positively, associated with rates of PTSD even controlling for exposure to
122 traumatic experiences (Dückers et al., 2016). Such observations suggest that alternative accounts
123 may be required.

124 Life history theory can again be a fertile source of possibilities. Emergency responses to
125 imminent threats are costly. The value of extensive responses thus hinges in part on the expected
126 frequency of crises, as frequent high levels of activation throughout adulthood will often not be
127 sustainable. If early experiences provide cues of the expectable adult environment, then, in the
128 service of sustainability, adverse early experiences may tamp down adult emergency reactivity.
129 Such a pattern is particularly adaptive if many of the most significant sources of adult mortality
130 are truly extrinsic, such that marshalling resources to address a source of danger will do little to
131 buffer the individual against the threat. Rather than being wasted in the fruitless pursuit of
132 longevity, such resources are instead better spent in enhancing reproduction. If PTSD constitutes
133 a pathological chronic hyper-activation of emergency responses, then, being less reactive to
134 crises, individuals with a history of adverse early experiences could actually be at lower risk of
135 PTSD – the opposite prediction to that of the deficit model. In this application of life history
136 theory, individuals who experience propitious early environments will deploy extensive
137 resources in the face of fitness insults in order to pursue longevity; ironically, however, this very
138 reactivity will make them vulnerable to pathologically excessive defensive responses that endure
139 long after a momentous threat has passed.

140 Epidemiological data support the association of early adversity with such physiological
141 and behavioral characteristics as faster development, more offspring, decreased self-investment,
142 higher preference for risk-taking, more selfish and less pro-social attitudes, steeper future
143 discounting and present-orientation, and a preference for shorter-term sexual relationships
144 (Belsky et al., 2015; Brumbach et al., 2009b; Carver et al., 2014; Fisher et al., 2011; McDermott
145 et al., 2021). In short, existing evidence suggests that there is indeed adaptive calibration of life
146 history trajectory early in life. However, it remains an open question whether such traits reflect a
147 phenotype in which the individual is more vulnerable to, or, conversely, better prepared for,
148 potentially traumatic experiences.

149 To explore the competing possibilities described above, using a large military sample,
150 we examined the extent to which early life adversity influences lifestyle and personality
151 characteristics in adulthood that, in turn, may correlate with PTSD risk. A military sample
152 affords relatively high rates of both exposure to traumatic events and PTSD, increasing statistical
153 power for detecting correlated traits. For much of the past two decades, the U.S. was actively
154 involved in armed conflict. Throughout this period, the U.S. military screened service members
155 for PTSD following deployment. Relative to the general population, U.S. military personnel thus
156 constitute a community both at greater risk of developing PTSD and more likely to have been
157 evaluated for PTSD. The Study to Assess Risk and Resilience in Servicemembers (STARRS)
158 dataset includes detailed records on exposure to potentially traumatic experiences, as well as
159 personal, health, and lifestyle data, allowing for a multiplex assessment of life history orientation
160 and its relationship with PTSD.

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Sample

Our data derive from the United States Army STARRS Consolidated All Army Survey (AAS), an epidemiological study that combined data across 3 surveys:

1. The core AAS, a survey administered from 2011 to 2012 in a probability sample of 17,462 active Regular Army, National Guard, and Army Reserve units worldwide, excluding soldiers deployed or in basic training;
2. A 2012 to 2013 AAS expansion that surveyed 3,987 deployed soldiers stationed in Afghanistan while in Kuwait awaiting transit to or from mid-deployment leave; and
3. The baseline STARRS Pre-Post Deployment Survey, which surveyed 8,558 soldiers in 3 Brigade Combat Teams shortly before deploying to Afghanistan in 2012.

Recruitment, informed consent, and data collection procedures, described in more detail elsewhere (Kessler, Colpe, et al., 2013), were approved by the Human Subjects Committees of the Uniformed Services University of the Health Sciences (Bethesda, Maryland) for the Henry M. Jackson Foundation (the primary grantee), the Institute for Social Research at the University of Michigan (Ann Arbor, the organization collecting the data), Harvard Medical School (Boston, Massachusetts), and the University of California, San Diego (La Jolla). All study participants gave written informed consent.

Information on handling bias, including sample weighting, response rate, and sample exclusions, is reported elsewhere (Kessler, Heeringa, et al., 2013). We focus on the 21,449 respondents who completed a survey. We excluded respondents who did not consent to link their administrative records to their survey for analyses that include service component as a covariate. In total, 17,462 soldiers who completed the survey consented to administrative data linkage. 180 respondents were omitted because survey data did not include PTSD symptom and/or age data. 1443 were excluded due to reporting subadult-onset PTSD. A further 3,730 respondents' data did not include one or more set of survey items on which we conducted our life history orientation principal components analysis. This left a sample of $n = 16,096$; see Supplemental Table 1 for sample characteristics.

Methods

Variables extracted from STARRS

PTSD

A majority of participants answered 9 PTSD checklist (PCL)-based survey questions about PTSD symptoms (Bliese et al., 2008). 4,102 of those did not record age of onset, so a second survey item (see Table 2) and its associated age of onset was used where present (Weissman et al., 2000).

Exposure level

Participants responded to fourteen questions about potentially traumatic experiences (PTEs) during deployment (e.g., combat patrol duty, assault, firing rounds at the enemy or taking fire,

201 being wounded in combat). Each question asked about the number of times each PTE occurred
202 during any previous deployment.

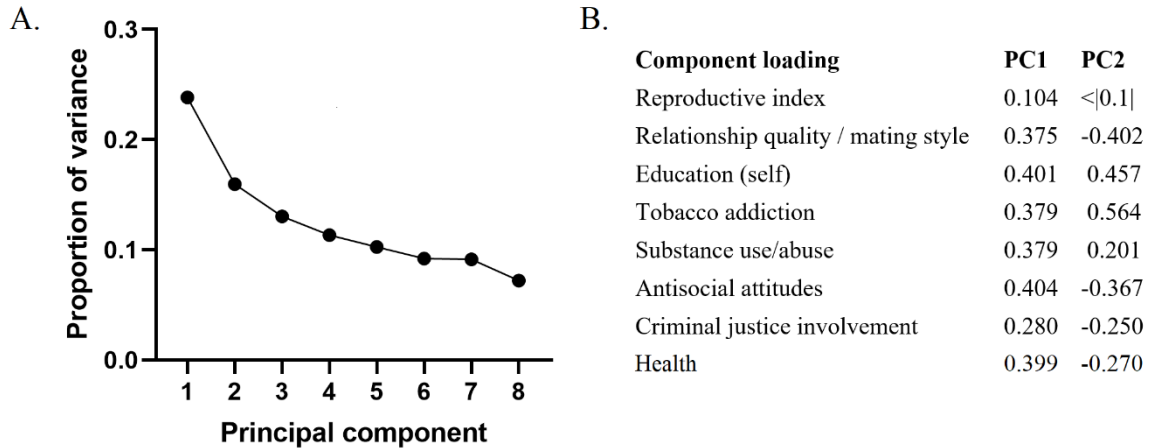
203 Early adversity measures

204 Parent's education. Maximum education level of either parent was used as a proxy for
205 childhood SES. The dataset values ranged from 1 (No education) to 8 (post-graduate, see
206 Supplemental Table 1).

207 Early head injuries. Childhood head injury sufficient to cause loss of consciousness,
208 eardrum perforation, memory loss, or dazing comprised the second measure of early adversity.
209 These four possible head injury conditions suffered in childhood were added together to form a
210 composite with a range of 0 to 4. The multiple durations of "loss of consciousness" were
211 collapsed into a binary value for the loss of consciousness injury condition prior to compositing
212 with the other early age head injury conditions.

213 Life history construct

214 From the wide array of survey items employed in the STARRS, we identified those
215 relevant to psychological traits hypothesized to be associated with differing life history
216 orientations, including self-investment, relationship quality, prosociality, and reproduction
217 (Brumbach et al., 2009a; Figueredo et al., 2006). Multiple survey items were composited for
218 each of the eight categories: relationship quality, education, health, tobacco addiction, substance
219 use and abuse, antisocial attitudes, criminal involvement, and number of children. When items
220 within the same category used different scales, items were normalized by dividing the value by
221 the maximum item value within each category. To facilitate interpretation of results, where
222 necessary, scales were inverted such that a higher numerical value was consistent with the
223 predicted trait associated with early adversity (see supplemental materials, life history category
224 construction). A principal component analysis was performed on the eight category composites.
225 The first principal component (PC1) accounted for a 23.8% plurality of the variance (see Fig. 1).
226 Every category composite loaded positively and, other than the number of children item, quite
227 substantially on PC1, therefore PC1 was selected as the life history orientation construct for
228 subsequent analyses.



229 Figure 1. Principal component analysis (PCA) of the lifestyle latent variables. A. Proportion of variance explained by each of the
 230 eight principal components. B. Loadings of PC1 and PC2 on the eight variables. For information on how the variables were
 231 constructed from the STARRS dataset, see methods and supplementary materials.
 232

233
 234 Covariates

235 *Age, race, sex, service component, location of the interview.*

236 Age was a continuous variable. Sex was a binary variable. Race was coded in three ways,
 237 white or not white, Black or not Black, or as a categorical variable with 8 levels (white, Black,
 238 Native American, Asian, Pacific Islander, Hispanic/Latino, bi-racial, or other). These were
 239 exclusive categories, i.e., individuals were placed in one and only one category. Multi-racial
 240 refers to individuals who checked yes to at least two of the categories. Service component was a
 241 categorical binary of active duty or not, in which “not” meant a member of the National Guard or
 242 Reserve who had been activated and deployed. Location of the interview was coded as a
 243 categorical variable with 3 levels: United States, overseas base, and overseas theater.

244 *Subjective coping resources.*

245 Subjective coping resources act as buffers against stress and adversity. These can include
 246 the degree of direct and indirect social support, as well as pre-trauma well-adjustedness. For
 247 deployed soldiers, their professional setting is also their de facto community and base of social
 248 support for months or longer. Therefore, their view of the degree of acceptance, respect, support,
 249 competence, fairness, and professionalism should be an important factor aiding them in coping
 250 with PTEs. The 14 items chosen for this composite included the participant’s rated morale,
 251 whether they feel discriminated against, the degree to which they can rely on peers and superiors
 252 for help, how well leaders treat soldiers, and whether they respect the unit leadership (for a
 253 complete list, see Supplemental Table 2). Coding of eight of the variables was inverted so that
 254 higher values consistently indicated greater subjective coping resources across all items. The
 255 items were normalized and averaged together to produce the coping resources composite
 256 variable.

257 *Resilience to stress.*

258 Participants responded to five items by indicating their ability to keep calm in a crisis;
259 manage stress; try new approaches when old ways do not work; get along with people when “you
260 have to”; and keep a sense of humor in tense situations. The encoding was inverted so that higher
261 values indicated increased self-reported resilience. They were summed to produce the resilience
262 composite variable.

263 *Statistical analysis*

264 Data were analyzed using RStudio version 1.4.1106. Principal component analysis was
265 used to extract the main axis of variation (PC1) from the eight compiled measures of life history
266 orientation described above. Probability of PTSD diagnosis was analyzed as a linear function of
267 multiple continuous and categorical predictor variables using logistic regression implemented
268 using the “glm” function and entering family as “binomial”. Fisher’s exact test was used for pair-
269 wise comparisons of the probability of PTSD diagnosis between two groups without correcting
270 for any covariates (e.g., two sexes, two races). Mediation analysis was conducted using the
271 mediation library in R. Two separate mediation analyses were conducted for each of the early
272 adversity measures: number of head injuries and parent’s education level. Specifically, the extent
273 to which each of the early adversity measures influenced PTSD probability via its influence on
274 the life history construct (PC1 from the principal component analysis; see above) was evaluated.
275 Correlations between two continuous variables were evaluated using Pearson’s correlation
276 coefficient.

277

278 **Results**

279 *Early adversity increases PTSD risk*

280 Analysis of PTSD risk as a function of early head injuries showed a positive correlation
281 by logistic regression (no covariates, slope = 0.3; $p < 0.0001$). Parent’s education was
282 significantly negatively correlated with PTSD risk (no covariates, slope = -0.035, $p = 0.01$). The
283 two measures of early adversity were weakly positively correlated with each other (Pearson’s $r =$
284 0.073; $p < 0.0001$).

285

286 *Life history metric*

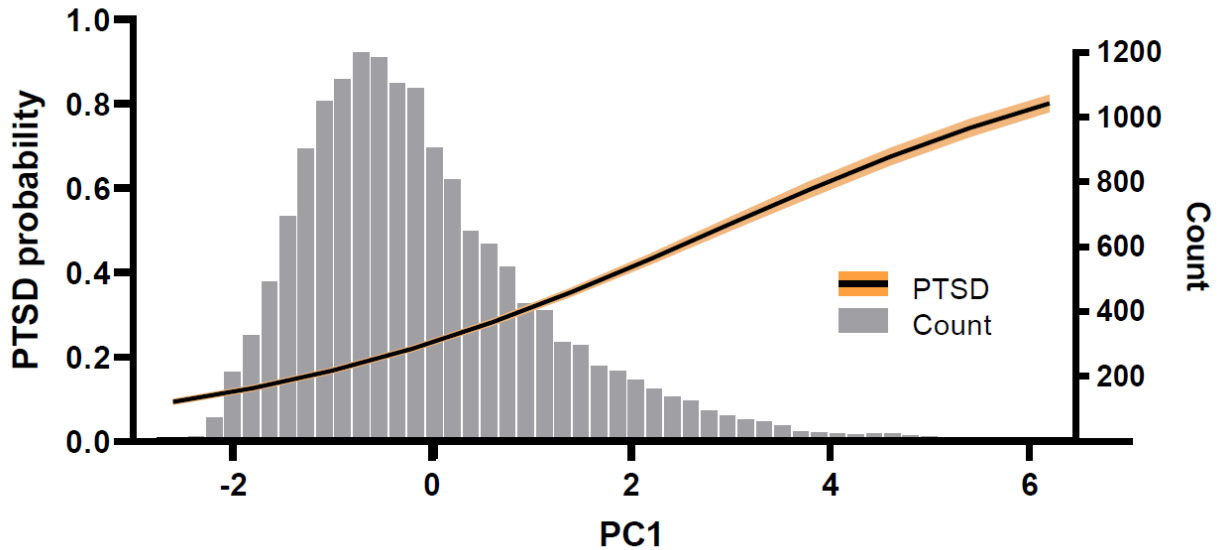
287 The first principal component (PC1) extracted from 44 variables (See Supplemental
288 Table 2) explained 23.8 % of the variation in the data (Fig. 1a). Each of the variables were
289 positively loaded on PC1, indicating that all the variables contributed to PC1 in the expected
290 direction, with weights shown in Figure 1.

291

292 *Life history strongly predicts PTSD risk*

293 In a logistic regression analysis predicting PTSD risk as a function of exposure, number
294 of head injuries in childhood, parent’s education, survey location, service component (active
295 duty versus guard/reserve), sex, coping, resilience, age, race, and PC1, all variables were
296 significant (type III sums of squares) except parent’s education (Table 1). Race was marginally
297 insignificant ($p = 0.057$). We analyzed race both as a categorical variable with 8 levels (see

298 above), and, on the presumption that, although many people of color suffer discrimination in the
 299 U.S., on average, Black individuals plausibly suffer the greatest disadvantage, as a binary
 300 variable (entered as Black or not Black). In all cases, race remained not significant (all $p > 0.05$).



301

302 **Figure 2.** Estimated probability of PTSD (+ SE) as a function of lifestyle orientation (PC1) and PC1 frequency histogram. PTSD
 303 probability is estimated from the linear model shown in Table 1, with all the covariates entered as average values from the
 304 sample, and in cases where the variables are categorical, we entered the first level as coded which ended up being male,
 305 active duty, base location. Lifestyle orientation as measured by PC1 is significantly positively associated with PTSD risk after
 306 controlling for all covariates in the full model.

307 **Table 1.** PTSD risk logistic regression model.

Coefficients:		Estimate	Std Error	z value	Pr(> z)	
Intercept		0.0661297	0.190663	0.347	0.728711	
Early age head injury		0.2211061	0.0241605	9.152	< 2e-16	***
Parent's education		0.0035155	0.016437	0.214	0.830643	
Location: base overseas		-0.1353677	0.0615893	-2.198	0.027955	*
Location: US		0.1164747	0.0443292	2.627	0.008602	**
Service component: active duty		0.1229113	0.0449158	2.736	0.00621	**
Service component: Guard/Reserve		-0.2372191	0.0725868	-3.268	0.001083	**
Deployment PTE exposure		0.0282604	0.0009696	29.148	< 2e-16	***
Sex (male)		-0.3920696	0.0323226	-12.13	< 2e-16	***
Age		0.0348802	0.0030193	11.553	< 2e-16	***
Coping		-1.6510042	0.1553754	-10.626	< 2e-16	***
Resilience		-0.0768164	0.005145	-14.93	< 2e-16	***
Race	White	-0.058453	0.0532114	-1.099	0.271984	
	African American	-0.1396394	0.0688697	-2.028	0.042602	*
	Native American	-0.3546507	0.1769375	-2.004	0.045029	*
	Asian	0.0995306	0.1157165	0.86	0.38972	

	Pacific Islander	0.2702698	0.1850988	1.46	0.144252	
	Other	0.0494713	0.1558409	0.317	0.750904	
	Mixed	0.1651128	0.100555	1.642	0.100587	
	PC1	0.1848043	0.063825	2.895	0.003786	**
	Resilience:PC1	0.0118682	0.0033352	3.558	0.000373	***
	ANOVA type-3		DF	Deviance	Pr(>Chi)	
	Early age head injury		1	82.95	< 2.2e-16	***
	Parent's education		1	0.05	0.8306318	
	Location of survey		2	7.6	0.0223668	*
	Service component (Guard/reserve)		2	13.13	0.0014102	**
	Deployment PTE exposure		1	899.75	< 2.2e-16	***
	Sex		1	141.84	< 2.2e-16	***
	Age		1	131.68	< 2.2e-16	***
	Coping		1	112.81	< 2.2e-16	***
	Resilience		1	224.48	< 2.2e-16	***
	Race		7	13.67	0.0574666	.
	PC1		1	8.59	0.0033826	**
	Resilience:PC1		1	12.45	0.0004188	***

308

309 *Race is not a significant predictor of PTSD risk even without correcting for covariates*

310 We also analyzed PTSD risk as a function of *only* race (Black or not Black) absent other
311 factors. The result was marginally not significant with the trend toward *reduced* PTSD risk for
312 Black soldiers ($p = 0.09381$). When all races were entered as a categorical variable (1-8), race
313 was also marginally not significant ($p = 0.05$).

314

315 *Sex is a highly significant predictor of PTSD risk*

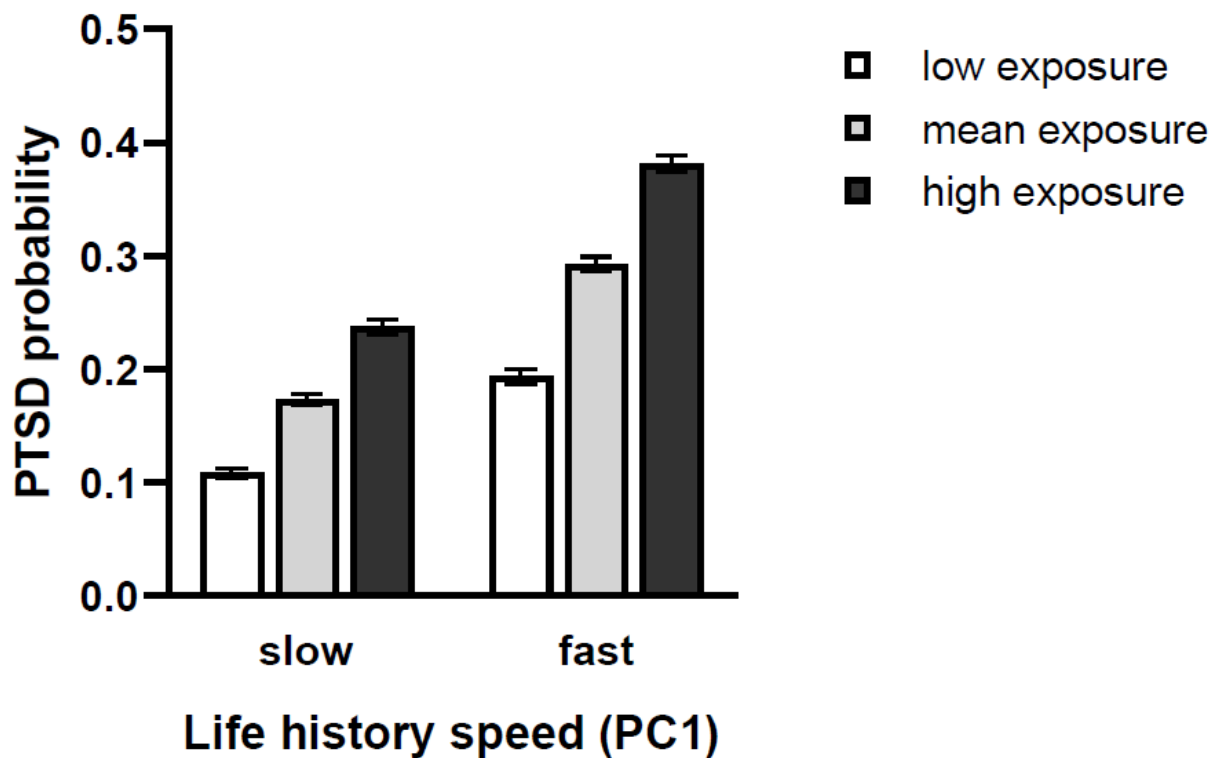
316 Without correcting for any covariates, women displayed a 1.27-fold increased risk
317 compared to men. This difference was larger (1.71-fold) after correcting for all covariates
318 (Supplemental Figure 1b).

319

320 *Number of traumatic experiences is also a strong predictor of PTSD risk*

321 Figure 3 shows the probability of suffering PTSD as a function of the number of
322 traumatic experiences (first quartile, mean, third quartile), separately for individuals with a low
323 versus high score for PC1 (first and third quartiles for PC1), illustrating the large effect that life
324 history orientation has on risk independent of the number of traumas experienced.

PTSD risk by life history speed



325

326 **Figure 3.** Estimated probability of PTSD (+- SE) shown for three levels of exposure to potentially traumatic experiences during
327 deployment for representative low versus high score for the lifestyle factor (PC1). PTSD risk increases with the lifestyle latent
328 variable independent of degree of exposure to potentially traumatic experiences during deployment. Estimates were from a
329 linear model that included all the covariates entered as average values from the sample, and in cases where the variables are
330 categorical, we entered the first level as coded which ended up being male, white, active duty, base location. Exposure levels
331 were the first, second, and third quartiles in the sample (Exp = 0.0, 19.3, 33.3). First and third quartiles were used for low and
332 high values for the lifestyle construct (PC1 = -0.885, 0.751).

333 *Guard and reserve soldiers had a marginally lower value for life history orientation, and lower*
334 *PTSD risk*

335 Active duty status was associated with increased PTSD risk after controlling for all
336 covariates ($s = 0.1852, p < .001, n = 1.$)

337

338 *Mediation analysis*

339 Results reveal that both early adversity measures affected PTSD risk via life history
340 characteristics. The number of early head injuries had a significant direct effect and a significant
341 mediation effect (Table 2). Approximately 25% of the total effect was mediated via life history
342 factors. Parent's education did not have a significant direct effect, but there was a significant
343 mediation effect (Table 2). Approximately 84% of the total effect was mediated by life history
344 factors.

345 **Table 2.** Mediation analysis

	estimate	p-value
Early-age head injuries		
effect		
direct effect	0.0368	<0.0001
indirect effect	0.0127	<0.0001
total effect	0.0504	<0.0001
proportion mediated by PC1	0.2515	<0.0001
Parent's education		
effect		
direct effect	-0.00102	0.3514
indirect effect	0.00607	<0.0001
total effect	0.005041	0.3526
proportion mediated by PC1	1.128891	0.076353

354 **Discussion**

355 The hypothesis that a life history orientation associated with early adversity could buffer
 356 against PTSD risk was not supported in our results. To the contrary, a life history orientation
 357 characterized by greater risk-taking, anti-social behavior, and fewer long-term investments was a
 358 potent positive predictor of PTSD risk. At the lower end of the life history orientation
 359 distribution (associated with a nurturing early environment), PTSD risk was about 15%; at the
 360 higher end (associated with a harsh early environment), this risk was over 50% (Fig. 2). This
 361 relationship held even controlling for exposure, early adversity, sex, age, race, resilience, and
 362 subjective coping resources. In our analytic model, a soldier at the low end of the life history
 363 construct (PC1 first quartile) would require more than double the number of exposures to
 364 potentially traumatic events to equal the PTSD risk for the high end (PC1 third quartile) given
 365 mean exposure. Few epidemiological PTSD studies have controlled for both the frequency and
 366 degree of exposure to potentially traumatic experiences and pre-existing childhood trauma.

367

368 *Evolutionary perspectives on PTSD*

369 To our knowledge, we are the first to hypothesize that a fast life history orientation might
 370 buffer PTSD risk. Our analysis does not support this hypothesis. Instead, it supports the
 371 prevailing deficit model, an account congruent with either constrained developmental
 372 canalization, or the dominant view among psychological life history theorists, namely that
 373 health, including mental health, is traded off against other demands among “faster” individuals
 374 (Del Giudice, 2014; Giosan & Wyka, 2009): the fast life history developmental syndrome
 375 sacrifices elements of phenotypic robustness in order to prioritize faster development and earlier
 376 reproduction, similar to the way that immune system competence and somatic maintenance are
 377 diminished. This appears to extend to the mind as well, with fewer resources dedicated to

378 managing substantial adversity because superlative (versus adequate) coping with such adversity
379 may principally benefit only those phenotypes betting on a longer life.

380 We acknowledge that it is difficult to fully adjudicate among the possible explanations
381 described above. While this application of life history theory can be seen as complementing the
382 standard deficit model, providing an account of ultimate causation that interdigitates with the
383 latter's proximate explanation, yet, by virtue of their complementarity, it is difficult to determine
384 whether one, the other, or the combination of these accounts is correct. Nevertheless, some
385 evidentiary space may exist between the stand-alone conventional deficit model and a version
386 thereof that is informed by life history theory. Specifically, in addition to making sensible the
387 relationships between early experience, adult lifestyle factors, and PTSD risk, it is possible that
388 the addition of life history highlights some aspects of developmental experience that
389 underspecified notions of "abuse and neglect" might otherwise overlook. For example,
390 investigators have only recently begun exploring the covariation between (conventionally
391 defined) adverse childhood experiences and childhood food insecurity (e.g., Baiden et al., 2021).
392 However, whereas a deficit approach explains the detrimental developmental effects of the latter
393 in terms of nutritional inadequacy, a life history perspective dictates that, even if nutritional
394 needs are met, the experience of food insecurity may constitute a developmental cue that, being
395 predictive of an adverse adult environment, results in a faster life history strategy (Nettle, 2017),
396 including both associated lifestyle factors and reduced investment in maintenance, with
397 corresponding increased vulnerability to disorders such as PTSD.

398 Lastly, adjudicating among the potential explanations for results such as ours is further
399 complexified by the possibility that patterns evident among contemporary soldiers in a highly
400 developed nation may reflect evolutionary disequilibrium. The virtues associated with a
401 nurturing environment, e.g., prosociality, conscientiousness, and self-investment in education
402 and skill, are all highly rewarded in the U.S. Conversely, potential virtues theorized to result
403 from a harsher environment, e.g., aggression, risk-taking, and short-term mating preferences, are
404 today punished by law or social censure. In addition, early adversity increases the risk of poverty
405 (Frederick & Goddard, 2007), and, in the U.S., poverty exacerbates and magnifies many
406 hindrances to flourishing that compromise coping resources, such as a lack of access to
407 healthcare, the inability to legally defend oneself from undue insults of the state, poor access to
408 quality education, poorer nutrition, and food insecurity.

409
410 *Early adversity*

411 Working within the constraints of the STARRS dataset, our lack of rich data on early
412 adversity is a significant limitation of the current study. The direct association between head
413 injuries during childhood and PTSD risk could be mediated by traumatic brain injuries, as
414 traumatic brain injuries have been associated with PTSD risk in previous studies (Hoge et al.,
415 2008; Miller et al., 2015; Schneiderman et al., 2008; Yurgil et al., 2014). The mediated effect
416 suggests physical damage to the brain also interacts with resulting life history orientation that, in
417 turn, increases PTSD risk. The SES proxy of parent's education was a weak but significant

418 positive predictor of the life history orientation composite variable (without covariates) and
419 PTSD (without covariates, see Figure S1 C), consonant with predictions and previous studies
420 (Bonanno et al., 2007; Breslau et al., 1998; Brewin et al., 2000; Koenen et al., 2007). The
421 mediation analysis suggests that the influence of parent's education on PTSD risk was nearly
422 entirely indirect, through its influence on the life history latent variable. More early adversity
423 measures that do not involve head trauma, such as other SES measures, witnessing violence,
424 losing family members, food insecurity, and harsh and inconsistent parenting, are needed to
425 strengthen the evidence for a positive association between early adversity and the life history
426 construct.

427

428 *Race*

429 We found a small, marginally non-significant effect of race, such that being Black,
430 arguably the most disadvantaged racial identity in the U.S., trended toward offering protection
431 from PTSD. The deleterious effects of discrimination and racism on mental health have long
432 been a focus in psychopathology research, particularly for Black and Latinx individuals in the
433 U.S. These effects are implicated in elevated rates or severity of depression, anxiety, and
434 substance use disorders among some racial minorities. The deficit model predicts substantially
435 increased PTSD rates for persecuted minority groups, particularly when exposure to potentially
436 traumatic experiences is higher. Although elevated risk for PTSD among minorities has been
437 reported (Breslau et al 2004), controlling for appropriate factors such as SES, life stress, and
438 degree of exposure tends to eliminate effects of race (Brewin et al, 2000; Bonanno et al, 2007;
439 but contra Roberts et al 2011). Accordingly, we conclude that direct measures of adversity and
440 lifestyle are likely more informative than race as regards PTSD risk.

441

442 *Age*

443 Previous studies generally find PTSD risk to be somewhat higher among younger adults
444 (Bonanno et al., 2007; Brewin et al., 2000). However, results from military samples have been
445 mixed in this regard (Xue et al., 2015). We found a small (slope = 0.035, $p < 0.0001$) positive
446 association between age (older) and PTSD risk when controlling for covariates. Holding aside
447 geopolitical vagaries that increase or decrease U.S. military engagement, among career soldiers,
448 age can be expected to correspond to total exposure to PTEs, hence a positive correlation with
449 PTSD is in keeping with the impaired-resilience account.

450

451 *Sex*

452 Consonant with numerous other studies, women exhibited higher risk of PTSD
453 (Supplemental Figure 2g). The disparity increased when covariates were controlled for,
454 increasing from 1.27 times to 1.71 times the risk for PTSD among men. Consonant with the
455 notion that, in an effectively polygynous species such as ours, females are characterized by a
456 slower life history orientation than males (Kruger & Nesse, 2006; Tarka et al., 2018), the mean
457 PC1 value was lower among women (-0.1274) than among men (0.1234). Nevertheless, the

458 benefits of lower values on our life history orientation factor were not enough to offset other
459 factors that magnify PTSD risk among women. In non-military samples, across cultures, women
460 evince greater anxiety, neuroticism, and pain sensitivity than men, and lower sensation seeking,
461 attributes which are consistent with a more cautious, harm-avoidant strategy consonant with
462 lower sex-specific variance in fitness (Benenson et al., 2021; Sparks et al., 2018). These
463 personality correlates themselves constitute risk factors for PTSD (Calegario et al., 2019; Jakšić
464 et al., 2012). Hence, although a slower life history orientation appears to generally buffer against
465 PTSD, the sex difference in PTSD risk may ironically owe to “slow” personality features which
466 are more common among women. We acknowledge, however, that it is an open question
467 whether results such as ours are explicable in this manner, as highly anxious, harm-avoidant
468 individuals are unlikely to volunteer for military service, and unlikely to be accepted or retained
469 if they do. Lastly, women suffer sexual assault in the military at far higher rates than men, and
470 this crime is likely significantly underreported (Wilson, 2018), hence the sex difference in PTSD
471 risk may partially reflect patterned differences in exposure to unreported potentially traumatic
472 experiences.

473

474 Limitations

475 As some of the above points suggest, a military sample is not representative of the U.S.
476 civilian population. It is demographically distinct, being mostly male and having many more
477 younger versus older adults, with service being restricted to those who meet many qualifications
478 of health and legal good-standing. Likewise, viewed cross-culturally, both the norms within the
479 U.S. military and the beliefs of the larger U.S. society are not representative of the diverse
480 meaning systems within which individuals may situate traumatic experiences, with
481 corresponding implications for some facets of PTSD (Zefferman & Mathew, 2021).

482 Importantly, as noted above, our measures of early adversity are quite limited, with only
483 a proxy for SES (parent’s education) and a few items comprising the head injury measure.
484 Consonant with the logic of the deficit model, head injury is associated with PTSD independent
485 of other factors, potentially confounding our use of this variable. For these reasons, the
486 connection we draw between early adversity measures and the life history orientation latent
487 construct is tenuous, though other studies have provided evidence of such a link (Brumbach et
488 al., 2009a).

489

490 Conclusion

491 Millions of Americans suffer debilitating effects of PTSD, some for many years. Effective
492 pharmaceutical and therapeutic solutions have remained elusive. Prevention is therefore all the
493 more important. In turn, efforts to prevent PTSD hinge on understanding underlying risk factors.
494 Early life adversity as a predisposing risk factor is both intuitive and empirically supported, and
495 appears to act in part through features of adult lifestyle characteristic of a fast life history
496 trajectory. With the caveat that our measures are subject to substantial limitations, our findings
497 bolster the prevailing view of developmental adversity as erosive to psychological capacities to

498 cope with trauma. Institutions, such as modern armed forces, in which exposure to potentially
499 traumatic events is likely to occur, may therefore better serve both their members and society at
500 large by assessing such risk factors during selection and training, and directing enhanced
501 resources to members at greater risk.

502

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512

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514 Daniel Fessler and Edward Clint conceived and designed the study and wrote the article. Edward
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516

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520

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522

523 Data availability

524 The data are available from the Inter-University Consortium for Political and Social Research
525 (ICPSR) at the University of Michigan (<http://doi.org/10.3886/ICPSR35197.v2>).

526 **Figure Legend**

527 **Figure 1.** Principal component analysis (PCA) of the lifestyle latent variables. A. Proportion of
528 variance explained by each of the eight principal components. B. Loadings of PC1 and PC2 on
529 the eight variables. For information on how the variables were constructed from the STARRS
530 dataset, see methods and supplementary materials.

531

532 **Figure 2.** Estimated probability of PTSD (+- SE) as a function of lifestyle orientation (PC1) and
533 PC1 frequency histogram. PTSD probability is estimated from the linear model shown in Table
534 1, with all the covariates entered as average values from the sample, and in cases where the
535 variables are categorical, we entered the first level as coded which ended up being male, white,
536 active duty, base location. Lifestyle orientation as measured by PC1 is significantly positively
537 associated with PTSD risk after controlling for all covariates in the full model.

538

539 **Figure 3.** Estimated probability of PTSD (+- SE) shown for three levels of exposure to
540 potentially traumatic experiences during deployment for representative low versus high score for
541 the lifestyle factor (PC1). PTSD risk increases with the lifestyle latent variable independent of
542 degree of exposure to potentially traumatic experiences during deployment. Estimates were from
543 a linear model that included all the covariates entered as average values from the sample, and in
544 cases where the variables are categorical, we entered the first level as coded which ended up
545 being male, white, active duty, base location. Exposure levels were the first, second, and third
546 quartiles in the sample (Exp = 0.0, 19.3, 33.3). First and third quartiles were used for low and
547 high values for the lifestyle construct (PC1 = -0.885, 0.751).

548

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720

721

SUPPLEMENT

Methods

Compositing of variables

Life history category construction

Relationship quality

Eight variables assessed relationship stability, investment, and quality (Supplemental Table S2). Other than the categorical variable for marital status, these survey questions were Likert scales. Values were divided by the item maximum value to normalize them because the range of each item varied. The resulting values of the eight were averaged to create a relationship quality composite variable.

Education quality (self)

Education quality is a composite of discrete numerical variables for maximum attainment and self-reported English reading ability. Attainment was inverted such that a higher value indicated lower education in order to align its polarity with the other constructed variables wherein a higher numerical value is consistent with the theoretical expectations of faster life history speed. All inverted variables were appended with the suffix INV in the R code. Both were normalized before being averaged to produce the composite.

General health

Participants reported experiencing ailments such as headaches, dizziness, fatigue, loss of appetite, body pains and sleep problems in the previous month. In all, 14 variables were used in this composite. Responses were Likert values associated with answers such as “All of the time” or “None of the time”. All 14 were inverted for life history alignment, normalized because of the use of different scales across items, and averaged together.

Tobacco addiction

Participants reported addiction, physical complications of tobacco use, and inability to cease use. Five binary variables and one inverted Likert variable were averaged together to produce the composite.

Substance use and abuse

Participants reported their frequency of consumption of alcohol, marijuana, and other illegal drugs in the past month. Five Likert survey items were inverted and averaged together to produce the composite.

Antisocial attitudes and behavior

Participants indicated the degree to which statements about illicit behavior resembled them. These included assaulting others, driving while intoxicated, lying for personal gain, and feeling justified in doing what others consider wrong. Five Likert items were inverted and averaged together to produce the composite.

Criminal involvement

Participants reported having spent time in correctional custody/jail, had “problems with police”, and receiving punishment under the Uniform Code of Military Justice such as Court Martial or Article 15 punishment. These three binary items were averaged together to produce the composite.

Reproduction index

The residuals of a linear model of number of offspring per year of sexual maturity (age 17 and older) were used as an estimate of each participant's reproduction. The residuals were used instead of the raw total number of offspring to account for the fact that older adults are capable of having more children than younger adults. This was supported by the analysis in which the slope was significantly positive and accounted for 25.6% percent of the variation (slope = 0.08 $p < .0001$).

Early age head injuries

The STARRS AAS dataset includes data on four broad types of head injuries differentiated by symptoms: loss of consciousness, becoming dazed and confused, eardrum perforation, and loss of memory. Frequency within type was not part of the dataset. The EAH composite is a sum of the types reported, 0-4.

Resilience

Five survey questions asked about the ability to handle stress. The responses were 1-5 Likert scales where 1 = Excellent and 5 = Poor. These values were inverted for clarity during analysis such that higher numbers indicated higher reported resilience. The composite is a simple sum of these values ($n=12$ records deleted for missing data).

Subjective coping resources

During deployments, a soldier's unit can practically become their friends, quasi-family, and community. Therefore, the subjective sense of support, interpersonal respect and confidence, and experiences of discrimination and favoritism in one's unit bear heavily on one's ability to manage adversity.

14 survey items were used. These Likert-based questions related to social and professional support within their unit ("I can rely on other members of my unit for help if I need it"; "leaders show concern about the safety of soldiers"), morale, and the perception of favoritism and discrimination. Eight of these were inverted for clarity such that higher values indicate better support or less reported discrimination.

Exposure to potentially traumatic experiences during deployment

14 survey items identified stressful experiences during deployment: combat patrols, firing at the enemy or taking fire, getting wounded by the enemy, nearly being injured or killed, having a unit member seriously injured or killed, being responsible for the death of an enemy combatant, being responsible for a non-combat death, being responsible for the death of an ally, saving the life of a soldier or civilian, seeing "homes or villages destroyed or people begging for food", exposure to severely wounded/dying people/dead bodies, witnessing violence within the local population or mistreatment toward non-combatants, being physically assaulted, and being sexually assaulted or raped. For each survey item, participants could indicate 0, 1, 2-4, 5-9, or 10 or more times. These responses were transformed as follows:

0 → 0
1 → 1
2-4 → 3.1
5-9 → 7
10+ → 10

The value 3.1 was used instead of 3 to avoid potential confusion of the transformed and non-transformed values during variable preparation and analysis in R. These fourteen values were summed to produce the exposure variable.

The fourteen items vary greatly in their traumagenic potency. We performed an analysis comparing the soldiers who experienced at least one of the four most traumagenic events (being wounded, killing the enemy, being assaulted, being sexually assaulted) to those who did not. There was no substantial effect on the primary findings of the correlations between PC1 and PTSD.

722 **Table S1.** Sample characteristics. n = 16,096.

Age	Range	18-61	Education	GED or equivalent	5.5
	Mean	28.8		High school	30.7
	STD	7.41		Some college	27.9
Sex		%	Technical school	6.0	
	Female	11.3	Associate degree	10.3	
	Male	88.3	Bachelor's degree	14.5	
Race		%	Graduate or professional	5.6	
	White	68.9	Military service component	%	
	Black	13.8		Active duty	82.3
	Native American / Alaskan Native	1.1		National Guard / Reserve	6.0
	Spanish/Hispanic/Latinx	5.4	PTSD	%	
	Asian	3.0		Yes	27.2
	Pacific islander	0.9		No	72.8
	Mixed	3.9			
Other	1.4				

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Relationship quality

- Marital status
- Relationship happiness
- Relationship divorce/separation/termination discussion frequency
- How often do you think "things going well" between you, partner
- How often do you confide in your partner?
- Handle disagreement with aggression (insulting, swearing, yelling, violence)
- How often your partner handles disagreement with aggression
- Relationships tend to have a lot of "extreme ups and downs"

Education

- Highest level of education completed
- Ability to read English

Tobacco addiction

- Unable to quit or cut down in spite of efforts to do so.
- Experienced withdrawal symptoms such as fatigue, headaches, constipation, trouble sleeping
- Experienced tobacco-related coughing, difficult breathing, lung trouble, heart or blood pressure problems
- Developed tobacco tolerance negating previous physical effects (e.g. nausea, irritability)
- Continued use in spite of physical problems that it caused.

Substance use/abuse

- Frequency of use of alcohol, tobacco, or drugs in past month
- Frequency of use of alcohol in past month
- Frequency of binge use (5x in one day) of tobacco, alcohol, drugs in past month
- Frequency of use of marijuana or hashish in past month
- Frequency of use of any other illegal drug in past month
- How often you needed an "eye-opener" drink in the morning to relieve shakes?

Antisocial attitudes and behavior

- I have done things against the law such as stealing
- I often have to lie to get what I want
- I sometimes hit other people so hard that they get bruises or require medical attention
- I sometimes do things that might indirectly harms others (e.g. impaired driving, not using protection during casual sex)
- I believe that I have been justified in doing some things other people might see as wrong

Criminal justice involvement

- Received Uniform Code of Military Justice (UCMJ) punishment in past year (e.g. Court Martial, Article 15, reprimand)
- Had trouble with the police, civilian or military in the past year
- Spent time in jail, the brig, or correctional custody in the past year

Health

- Poor appetite or overeating in past month
- Headaches in the past month
- Pain in back, neck, arms, legs, or joints in the past month

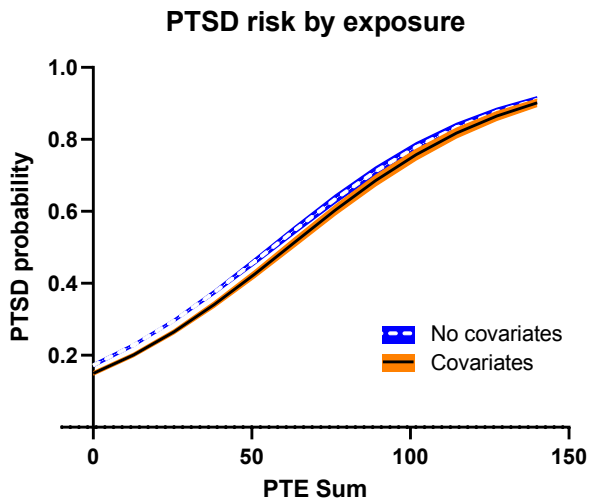
Muscle tension in the past month
Dizziness in the past month
Fainting spells in the past month
Memory problems in the past month
Difficulty concentrating in the past month
Irritability in the past month
Balance problems in the past month
Ringing in ears in the past month
Sleep problems in the past month
Feeling tired / low energy in the past month
Easily fatigued in the past month

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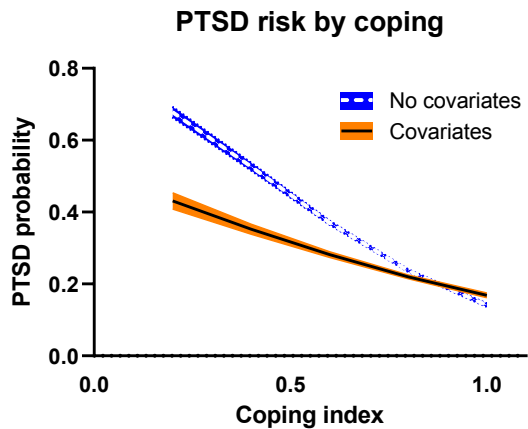
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Figure S1

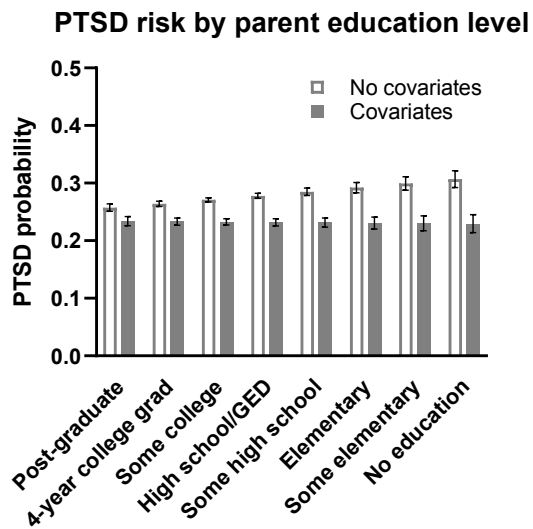
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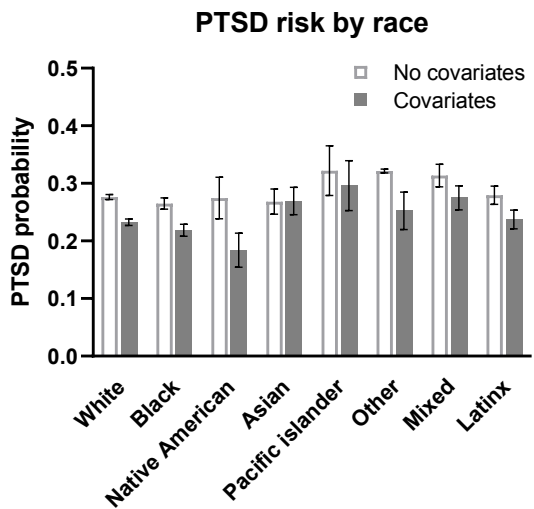
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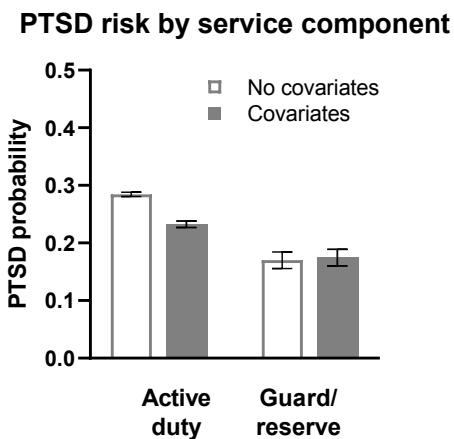
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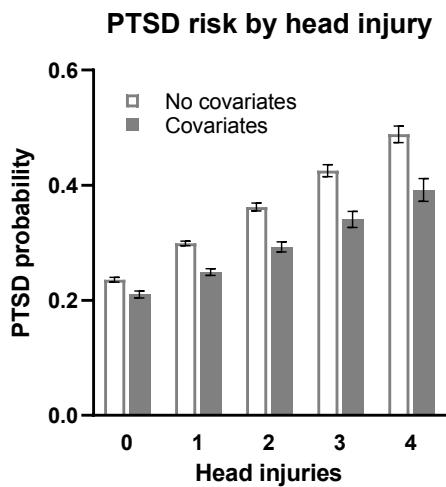
D.



E.



F.



G.

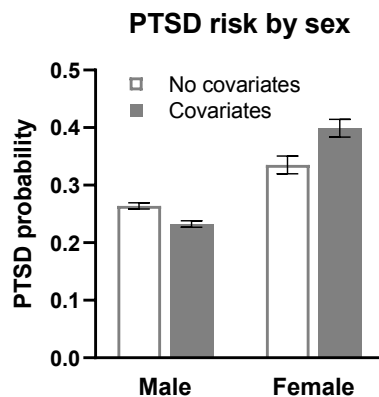


Figure S2

