



## Childhood adversity is associated with adulthood white blood cell count through narcissism

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### ARTICLE INFO

#### Keywords:

Childhood harshness  
Childhood unpredictability  
Life history strategy  
Dark Triad  
White blood cell count

### ABSTRACT

The immune system's response to threat is to amass protective white blood cells. We investigated ( $N = 234$ ) individual differences in white blood cell (WBC) through the lens of life history theory by examining individual differences in (self-reported) childhood threats (i.e., unpredictability and harshness), life history speed, and the Dark Triad traits (i.e., Machiavellianism, narcissism, and psychopathy). People with adverse childhood conditions had faster life history strategies and higher Dark Triad traits, and were more prone to be inflamed (i.e., sexually transmitted infections). In addition, men reported more childhood harshness, Machiavellianism, psychopathy, and a faster life history strategy and a higher WBC count than women did. Moreover, we revealed, through structural equation models, that the effects of childhood adversity on adult WBC count were mediated by narcissism especially in women. Results are discussed in terms of the mechanism underlying the association between childhood environments and physiological health.

### 1. Introduction

It is a truism to say that childhood adversity has profound implications for one's adulthood (Ellis et al., 2009). Childhood adversity has been linked to physical and psychological symptoms later in life (Brumbach et al., 2009). Childhood harshness (e.g., resource scarcity, pathogens, climate extremes, and predator threats) increases morbidity and mortality, whereas unpredictable childhood conditions lead to beliefs that the world is capricious and irregular, thus limiting the appeal of long-term, mutually beneficial relationships. In response to childhood stress, people's bodies respond as if they were responding to physical stress (e.g., viruses) with elevated white blood cell (WBC) count, a process called inflammation (Bae et al., 2020; Todd, 1974).

The immune system produces WBCs to defend the body against infection. Basal levels of WBC are one of the first lines of defense against infectious disease (Nunn et al., 2000). Neutrophils and lymphocytes are the most common WBCs. Neutrophils, as part of the innate immune system (i.e., neutrophil elastase), respond to acute and suppurative infections, whereas lymphocytes, as part of the adaptive immune system

(i.e., T-lymphocyte), determine the specificity of immune response. Epidemiological studies have shown that elevated WBCs are associated with psychological stress (O'Donovan et al., 2012) and cardiovascular disease (Ruggiero et al., 2007), and having a chronically elevated WBC count is a biological marker for inflammation and traumatism (Ruggiero et al., 2007). Consistent with previous studies, we used individual differences in WBC counts as a marker for the systemic inflammatory response (Bae et al., 2020; Todd, 1974).

Unfortunately, research on how childhood adversity is associated with mechanisms is rather limited. Rarely do researchers use an objective measure of adult health nor have researchers tried to understand the role of personality traits as mediators between childhood conditions and immune systems responses. In this study, we adopt a life history framework to understand how childhood conditions influence adult WBC count, using enumerative immune assays, and examine how personality traits may amplify this association.

One way of understanding why people who have experienced adverse childhood conditions have psychological and physical responses, including increased WBC count, is offered by life history

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<https://doi.org/10.1016/j.paid.2021.110662>

Received 11 August 2020; Received in revised form 11 January 2021; Accepted 12 January 2021

Available online 5 February 2021

0191-8869/© 2021 Published by Elsevier Ltd.

strategy. Life history theory (Rushton, 1985) describes how organisms deal with trade-offs between investment in growing and maintaining their body (i.e., somatic effort) and engaging in parenting and mating (i.e., mating effort). For example, species that trade-off somatic for mating efforts tend to live long, mature slowly, have few offspring, invest in those offspring highly, and are often cognitively and socially complex (e.g., chimpanzees, elephants, humans). These species are said to have a *slow* or a *K*-selected species. Contrast those to *fast* or *r*-selected species who tend to live short lives, mature quickly, have many offspring, and are less cognitively and socially complex (e.g., rats, lizards, frogs). Previous studies established that there exists an internal route of life history calibration (i.e., internal predictive adaptive responses) (Nettle et al., 2014). Specifically, environmental cues calibrate life history strategies both behaviorally and physically (Chang et al., 2019). For example, childhood sexual abuse predicts substance use and sexual risk-taking during adolescence (Draucker & Mazurczyk, 2013).

Organisms that have unstable and unpredictable environments tend to have faster life history strategies in nature because the pay-off for doing so is higher than investing in slower strategies. One recurrent feature of these harsher environments might be pathogens and thus, individuals' bodies, when experiencing such environments, may activate global response systems in the form for psychological and physical shifts including changes in personality and WBC count. This is because engaging in faster life history strategies will have recurrently put organisms at risk of infection by new pathogens from sex or opportunistic feeding (e.g., scavenging) and having an inflammatory response a priori would have served as a stopgap to recurrently impending pathogens and bacteria despite the potential for shortened life expectancies (Gassen et al., 2019). Trade-offs is the core concept to the life history theory. For example, children living in harsh and unpredictable environments may face the trade-off between investment in growing and maintaining their body: children who invest more energy in fighting infection will have less energy available for physical development (McDade, 2003).

Individual differences in life history strategies can be measured directly (Figueredo et al., 2006) or indirectly through the assessment of personality traits like the Dark Triad (Jonason et al., 2010). The Dark Triad traits (Paulhus & Williams, 2002) are three interrelated but independent personality traits of Machiavellianism (i.e., manipulation and cynicism), narcissism (i.e., vanity and self-centeredness), and psychopathy (i.e., callous social attitudes and amorality). These traits are linked to agentic behaviors and insensitivity during social functioning (Jones & Figueredo, 2013) which implicates them (or aspects of them) as fast life history traits (Jonason et al., 2010, 2017). If the traits are indicators of such an approach to life, they may have a correlated inflammatory response. Such a response could be (1) because they are exposed to more pathogens (i.e., a symptom) like sexually transmitted infections from casual sex (Jonason & Lavertu, 2017), more illegal (i.e., marijuana) and legal (e.g., alcohol) substance use (Stenason & Vernon, 2016) and impulsivity (Jones & Paulhus, 2011) which may adversely affect their health. or (2) because chronic activation of one's immune system may be part of the global acceleration of the person's life history strategy leading to shortened life expectancy at the gain of immediate rewards (Jonason et al., 2015).

Beyond childhood conditions, there are recurrent sex differences in life history speed (Figueredo et al., 2005) and the Dark Triad traits (Jonason et al., 2020). Overwhelmingly, men are more likely to be antisocial, agentic, disagreeable, and fast. We expect to replicate such sex differences. Further, we postulate that as a function of men's characteristically faster life history strategy, men should have a higher WBC count than women do. Indeed, WBC count is higher when individuals have more mating partners (Nunn et al., 2000), risk-taking (Sutin et al., 2012), and substance use (Helyes et al., 2017). Beyond these basic tests, we build a theoretical model (i.e., SEM) that originates from childhood conditions, to life history speed, then to specific manifestations of life history speed in the form of the Dark Triad traits, and finally which leads to WBC count. We also suggest that this mediation might be further

qualified by a moderation effect of participant's sex.

In the current study, we provide the first study linking the Dark Triad traits and life history speed in humans to the inflammatory response as measured with individual differences in WBC. We further test the distal role of childhood conditions in predicting these individual differences, because such conditions may physically expose people to more risk and it may set-up expectation biases that push people toward a faster life history strategy but also to have an inflamed immune response. From this perspective, we predicted that (a) men will have faster life history, a will have a harsher childhood, score higher on the Dark Triad traits, and have a higher WBC count than women do, (b) childhood adversity will be associated with faster life history strategy and higher scores on the Dark Triad traits, and (c) childhood conditions will predict variance in WBC count through the mediating effects of fast life history strategy and high Dark Triad traits.

## 2. Method

### 2.1. Participants and procedure

Participants were 234 (49.6% female) Chinese adults ( $M = 24.20$  years,  $SD = 5.08$ ,  $Range = 18-55$ ), who volunteered to partake in a study that assessed their personality and had a physical exam. Participants were recruited between June 2017 and July 2018 from Zhengzhou University Hospital and remunerated with a gift ( $\approx 5$ CNY).

The survey consisted of a medical examination and a self-reported questionnaire. Permission from the College Institutional Research Ethics Board and participants' consents were obtained. After consent was obtained via signature, participants received the physical exam (on an empty stomach), completed a demographic measure, and (in groups of 5–10 people) completed a self-report, paper-and-pen questionnaire. The investigation was carried out in accordance with the latest version of Declaration of Helsinki. Upon completion, participants were thanked and debriefed.

### 2.2. Measures

We used the Chinese version (Geng et al., 2015) of the Dirty Dozen (Jonason & Webster, 2010) measure to assess individual differences of the Dark Triad traits. It is composed of 12 items (4 per trait) where participants reported their agreement (1 = *strongly disagree*; 7 = *strongly agree*) to items capturing individual differences in Machiavellianism (e.g., "I tend to manipulate others to get my way"), narcissism (e.g., "I tend to want others to admire me"), and psychopathy (e.g., "I tend to be unconcerned with the morality of my actions"). Items were averaged to create indexes of Machiavellianism (Cronbach  $\alpha = 0.72$ ), narcissism ( $\alpha = 0.64$ ), and psychopathy ( $\alpha = 0.85$ ).

We measured life history speed with the Chinese (Chen et al., 2017) version of the Mini-K (Figueredo et al., 2006). Participants reported their agreement (1 = *strongly disagree*; 7 = *strongly agree*) with 20 items (e.g., "I try to understand how I got into a situation to figure out how to handle it"), scored from fast-to-slow. Items were averaged to create an index of life history speed ( $\alpha = 0.83$ ).

We measured environmental harshness by self-reported exposure to violence (Brumbach et al., 2009). Participants were asked how often (1 = *never*; 7 = *always*) seven items (e.g., "You got into a physical fight") occurred before they were 12 years old. This scale was forward-and back-translated from English to Mandarin and it was a unidimensional measure ( $\chi^2/df = 1.34$ ,  $RMSEA = 0.009$ ,  $IFI = 0.96$ ,  $CFI = 0.95$ ) that was internally consistent ( $\alpha = 0.75$ ). The translation is available in the online supplements.

We measured environmental unpredictability by frequent changes or ongoing inconsistency in childhood environments (Brumbach et al., 2009). We removed three of the ten items because homeless shelters are uncommon in China. Participants reported how often (1 = *never*; 7 = *always*) the seven remaining items (e.g., "By the time you started 6th

grade, how often had your parents or other adult caregivers left you home alone when an adult should have been with you?") happened to them. This scale was forward- and back-translated from English to Mandarin and it was a unidimensional measure ( $\chi^2/df = 1.75$ , RMSEA = 0.057, IFI = 0.92, CFI = 0.91) and was weakly internally consistent ( $\alpha = 0.62$ ). The abbreviated translation is available in the online supplements.

To measure inflammation, blood samples were drawn following the routine blood test procedure in the morning (8:00 to 11:00 a.m.) after an overnight fast. Whole venous blood samples from an antecubital vein in the supine position and collected by BD vacutainers blood collection tubes (Becton, Dickinson, and Company). All samples were determined by automatic hematology analyzer (Sysmex K-1000, Norderstedt, Germany).

**3. Result**

We report basic analyses in Table 1. Men (compared to women) had faster life history traits in terms of overall speed and in terms of the Dark Triad traits, harsher childhoods, and higher WBC count. Higher WBC count was associated with more childhood harshness but not unpredictability, and a faster life history speed (high values are slow LHS), and narcissism. Childhood adversity (in both forms) was positively associated with a faster life history speed overall and in the Dark Triad traits; a faster life history speed was positively associated with Machiavellianism and psychopathy.

We conducted two (Figs. 1 and 2) structural equation models (Arbuckle & Wothke, 1999). We hypothesized that the childhood adversity (i.e., harshness and unpredictability) were independent variables, life history strategy and Dark Triad traits were mediating variables, and WBC count was the dependent variable. Because childhood harshness and unpredictability were correlated, when we ran the models, either childhood harshness or childhood harshness was controlled. Before running the model, all missing data (<1%) were replaced with sample means. The model fit indices indicated good fit for Fig. 1 ( $\chi^2/df = 1.49$ , TLI = 0.94, CFI = 0.95, RMSEA = 0.05) and 2 ( $\chi^2/df = 1.63$ , TLI = 0.92, CFI = 0.94, RMSEA = 0.05).

Figs. 1 and 2 suggest that childhood adversity was indirectly associated with higher WBC count through higher narcissism; indirectly associated with higher Machiavellianism and psychopathy through faster life history strategies; childhood harshness was directly associated with higher psychopathy. The only direct effect, in either model, on WBC count was narcissism. The total effect of harshness on WBC was 0.18, where the direct effect as 0.12, and the indirect effect through narcissism was 0.06; the total effect of unpredictability on WBC was -0.01, where the direct effect was -0.05, and the indirect effect through narcissism was 0.04.

Given the sex differences in almost all study variables, we conducted

multi-group analyses to examine whether the models differed across the sexes. We applied equality constraints to all paths except participant's sex as a control. The relation between childhood harshness and narcissism ( $\Delta RMSEA = 0.001$ ,  $\Delta CFI = 0.003$ ,  $\Delta TLI = 0.005$ ,  $p = .02$ ) and the relation between childhood unpredictability and narcissism ( $\Delta RMSEA = 0.001$ ,  $\Delta CFI = 0.004$ ,  $\Delta TLI = 0.005$ ,  $p < .02$ ) differed in men and women (Fig. 3). It appears (although not predicted) that the mediating role of only narcissism on the relationship between childhood adversity and WBC count was stronger for women than men (i.e., moderated-mediation).

**4. Discussion**

We provide here the first life history account of individual differences in WBC count and a more nuanced assessment of the role of personality and sex differences in how childhood conditions may account for those individual differences in WBC count. First, we replicated prior work suggesting that men scored higher in life history strategy (Figueredo et al., 2005) and the Dark Triad than women do (Jonason et al., 2020). Second, we found the positive relationship among childhood conditions, the Dark Triad traits, and WBC count (Chen et al., 2017). Third, the SEM models revealed childhood conditions predict WBC count through fast life history strategy and high Dark Triad traits (especially in narcissistic women), which support of the notion that the Dark Triad traits may be condition-dependent adaptations to solve life adaptive problems in the face of harsh and unpredictable world (Jonason et al., 2019). Overall, the findings of the present study offer several interesting insights into the behaviors and underlying psychological processes associated with childhood adversity.

Consistent with previous research (Figueredo et al., 2005; Jonason et al., 2020), we were able to replicate some sex differences. Compared to women, men scored higher on Machiavellianism and psychopathy, and lower on life history strategy, thus suggesting that men are more likely to be antisocial, agentic, disagreeable, and fast. Because of the different roles and divisions of labor, men usually use high risk and high reward niche specializations to conquer out-group members, while women avoid directly competing and prefer a fixed partner to get survival resources. Moreover, as expected, the WBC count was higher in men than women, which is consistent with our hypothesis that men with a fast life history strategy and higher Dark Triad traits, tend to have more casual sex (Nunn et al., 2000), risk-taking behaviors (Sutin et al., 2012), and substance use (Helyes et al., 2017), and these systematic patterns will recurrently put organisms at risk of infection and other injuries, and thus induce an inflammatory response to recurrently impending risks.

As predict, WBC count was associated with retrospective perceptions of childhood harshness, although the correlation was small. This revealed that adverse childhood experiences may have negative effects on the nervous, endocrine, and immune systems (Cole et al., 2012). For

**Table 1**  
Correlations between childhood adversity and all variables.

	1	2	3	4	5	6	7
1. Childhood unpredictability	–						
2. Childhood harshness	0.39**	–					
3. Life history speed	-0.28**	-0.25**	–				
4. Machiavellianism	0.18**	0.18**	-0.26**	–			
5. Psychopathy	0.23**	0.29**	-0.39**	0.45**	–		
6. Narcissism	0.16*	0.27**	-0.08	0.31**	0.12	–	
7. White blood cell count	0.04	0.16*	-0.17*	0.09	0.05	0.15*	–
Overall M (SD)	8.94 (1.82)	8.78 (1.52)	93.75 (12.66)	6.28 (3.08)	6.35 (2.92)	16.44 (5.75)	5.60 (1.45)
Women M (SD)	0.94 (1.97)	8.41 (1.23)	96.10 (11.98)	5.87 (2.99)	5.78 (2.37)	15.79 (6.15)	5.36 (1.35)
Men M (SD)	8.94 (1.68)	9.15 (1.68)	91.46 (12.93)	6.67 (3.14)	6.91 (3.29)	17.07 (5.29)	5.83 (1.50)
t	<-0.01	3.85	-2.84	2.00	3.00	1.70	2.53
p	0.99	0.00	0.01	0.00	1.70	0.09	0.01
Cohen's d	0.00	0.50	-0.37	0.26	2.53	0.22	0.33

\* p < .05.  
\*\* p < .01.

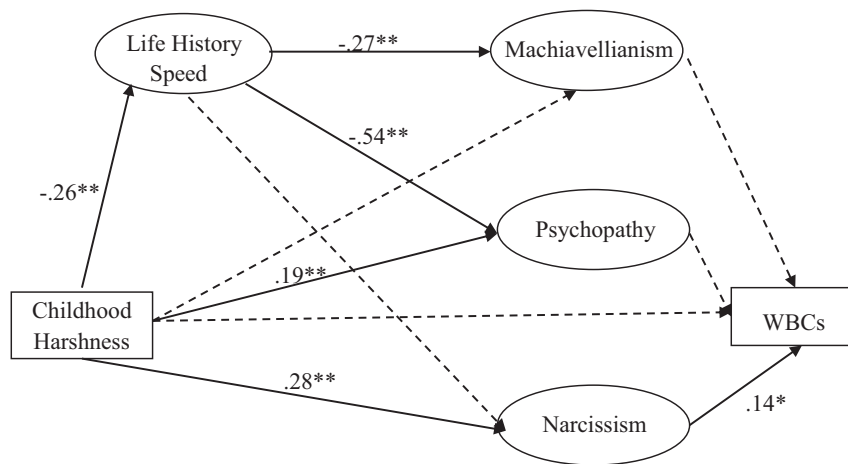


Fig. 1. Hypothesized model testing the influence of childhood harshness on WBC count  
 \*  $p < .05$ , \*\*  $p < .01$ ; Dotted line indicate non-significant paths.

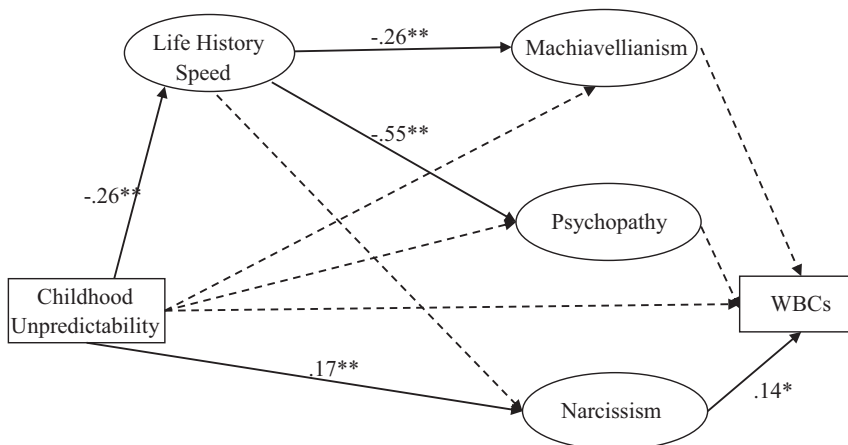


Fig. 2. Hypothesized model testing the influence of childhood unpredictability on WBC count  
 \*  $p < .05$ , \*\*  $p < .01$ ; Dotted line indicate non-significant paths.

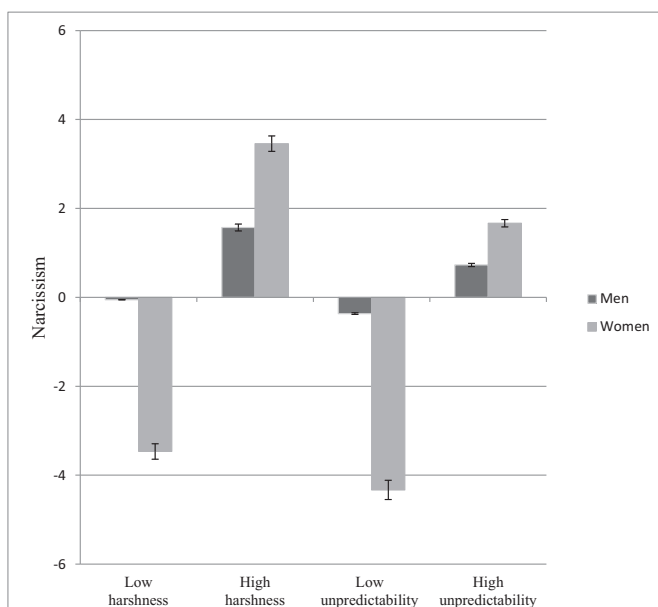


Fig. 3. Narcissism as a function of childhood adversity and sex.

example, a recent longitudinal study found that early childhood adversity had adverse effects on the volume of a subregion of the pre-frontal cortex, the inferior frontal gyrus, resulting in impairment in emotional intelligence and increased risk for adolescent depression and poor physical health (Luby et al., 2017), while the Dark Triad traits are associated with empathy deficits (Heym et al., 2019), depressive symptoms (Shih et al., 2019), and self-reported health problems (Malasza & Kaczmarek, 2019). Additionally, higher perceived childhood adversity was associated with faster life history strategies, as well as Dark Triad traits, where evidence shows that these three traits may be indicators of a fast life history strategy (Jonason et al., 2010, 2017). Also, the Dark Triad traits might be phenotypic responses to pre-determined and evolutionary relevant information (Jonason et al., 2019).

As hypothesized, the present study was able to provide insight into the underlying psychological systems that may be associated with WBC count. SEM revealed that childhood adversity indirectly increased WBC count through narcissistic tendencies. This suggests that when the environment is harsh and unstable, the genetically prepared phenotype is updated by developing dark personalities (especially narcissism) and acting accordingly (such as casual sex, risk-taking and substance use), and then triggers an immune response to increase WBC count to fight stress. This demonstrated that the Dark Triad traits is a response of environmental stress, promotes antagonistic and psychopathic attitudes,

which then increase positive attitudes toward casual sex and short-term mating. (Patch & Figueredo, 2017). Similarly, this epigenetic effect supports adaptationist interpretations by suggesting that there may indeed be some fitness gains to these dark traits (Jonason et al., 2019).

Incidentally, the current study revealed that only women showed a significant childhood adversity-narcissism slope (Fig. 3), thus demonstrating that the above mediation might be qualified by a moderation effect of participant's sex (i.e., moderated-mediation) albeit potentially underpowered as a test. If true, (1) narcissism may be sensitive to variance in childhood conditions in women and (2) women are more likely to suffer for engaging in behaviors linked to narcissism and to pay the greatest costs in life outcomes including WBC count. Such a result is consistent with research demonstrating that women are more sensitive to socio-ecological conditions than men are (Del Giudice & Belsky, 2010). For example, in the recessionary times, women might engage in the so-called "lipstick effect" (Hill et al., 2012), and female pubertal timing is associated with early experiences more than male pubertal timing (Del Giudice & Belsky, 2010).

Consistent with the findings of Patch and Figueredo (2017), we found that when the environment is harsh and unstable, the genetically prepared phenotype is updated by accelerating life history speed, and then increase Machiavellian and psychopathic tendencies are observed. These results suggest that the predictive effects of childhood adversity on Machiavellianism and psychopathy were facilitated by a faster history strategy (Ellis et al., 2009; Jonason et al., 2016). Additionally, SEM analyses revealed that childhood harshness still had direct contributions to psychopathic tendencies. Our findings provide empirical support for an adaptationist model by demonstrating that developing the Dark Triad traits, partially through environment harshness and unpredictability, then triggers an immune response to increase WBC count to fight stress.

Despite the novelty and theoretical rigor of our study, several limitations inherent to the present study should be considered. First, our data was retrospective. While some researchers have found adult recollections of childhood trauma are reliable (Levine et al., 2015), it is possible that the participants in the current study recollected their childhood in a way that was consistent with their present symptom content. Nevertheless, the use of self-reported data and objective data in the current study, helped reduce the potential bias. Another caveat that might impede the generalization of our results is the cross-sectional study design, which could not demonstrate causal effects between childhood adversity and inflammatory. Future research should consider a longitudinal design to deepen the processes understood linking childhood adversity to WBC. Finally, we did not collect childhood health problems, which may be an important factor causing inflammatory load that can persist into adulthood. Additional research is needed to find out whether socioeconomic status, social support, drinking, and smoking are moderators for elevated inflammation.

As a final note, the current study provides additional evidence for the relationships between childhood environment, personality traits, and health in men and women. We provide greater understanding of the processes that lead to physical and psychology health by considering a fuller range of environmental and personality variation, and argue that childhood conditions predict WBC count through fast life history strategy and high Dark Triad traits (especially in women). However, environment, personality, and health rely on a complex regulatory network, influenced by many factors, future research should control more covariates to obtain more objective and accurate results.

#### Institutional ethics committee approval

The survey consisted of a medical examination and a self-reported questionnaire. Appropriate permissions from the College Institutional Research Ethics Board and participants' consents were obtained. The investigation was carried out in accordance with the latest version of Declaration of Helsinki.

#### CRedit authorship contribution statement

Yaoguo Geng, Xueying Sai, and Minqi Yang: research design and protocol, data collection and analysis, raw paper and revision; Peter K. Jonason: research design, paper revisions and corrections; Xueli Zhu, Jingjing Gu, Huijuan Kong: research design and protocol, data collection and analysis, paper revisions.

#### Declaration of competing interest

The authors declared no conflict of interest including any financial, personal or other relationships with people or organizations.

#### Acknowledgement

(1) This work was supported by Education Programs of National Social Science Fund of China (BBA170064).

(2) This work was also funded by the Henan Philosophy and Social Science Foundation (2019CJY038).

(3) This work was also funded by Cultivation plan of excellent young scientific research team in Humanities and social sciences of Zhengzhou University.

(4) Peter Jonason was partially funded by a grant from the National Science Centre of Poland (2019/35/B/HS6/00682).

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