LEBS
Vol. 8 No.2 (2017) 36-39
Letters on Evolutionary Behavioral Science

Does Perceived Vulnerability to Disease Predict Life-History Strategy in Japanese Adults?

Ryo Oda*

Nagoya Institute of Technology, Nagoya 466-8555, Japan

*Author for correspondence (oda.ryo@nitech.ac.jp)

Humans are a slow life-history strategy species compared to other animals. However, individual differences occur within species. Individuals develop in a flexible manner to choose the best life-history strategy in response to internal and external factors, such as the unpredictability of the environment. The burden of lifespan-limiting disease, over which one feels little control, could be a factor modulating life-history strategy. This study investigated the effects of perceived susceptibility to disease and germ aversion on individual differences in life-history strategy using a large sample of Japanese adults. The results indicate that the effects of perceived susceptibility to infection and germ aversion on life-history strategy was much weaker than that of a harsh socio-economic environment, which did not support results of a previous study. This may have been due to the special environment of contemporary medical care in Japan, wherein medical standards are very high and mortality rates are relatively low.

Keywords
life history theory, perceived vulnerability to disease, immune function, health

Introduction

As available resources and time are limited for animals, they have evolved to adequately allocate these factors during their lifespan. According to life-history theory, all animals face a fundamental trade-off when allocating energy and resources between somatic effort (effort that organisms devote to their own development) and reproductive effort. The contrast between r- (fast life-history) and K- (slow life-history) strategies has been used to illustrate the variability of species-specific energy allocation (Pianka, 1970). A fast life-history strategy is associated with smaller body size, faster sexual maturation, more mates and offspring, and lower investment in the offspring, whereas a slow life-history strategy is characterized by larger body size, slower sexual maturation, fewer mates and offspring, and higher investment in the offspring. Although humans are a slow life-history strategy species, individual differences occur within species. As individuals develop in a flexible manner to choose the best life-history strategy in response to their environment (Del Giudice, Ellis, & Shirtcliff, 2011), the unpredictability of the environment during development could affect the choice of strategy. For example, parental behavior and investment can provide useful cues about the ecological conditions that offspring will face in the future (Del Giudice & Belsky, 2010). In addition, extrinsic mortality risk factors, such as the homicide rate or famine in the environment, play a key role in modulating life-history pathways (Ellis, Figueredo, Brumbach, & Schlomer, 2009).

The burden of a lifespan-limiting disease, over which one feels little control, may modulate life-history strategy. As deficiencies in immune function heighten the risk for infection and disease, we can predict that low immunocompetence encourages the adoption of a faster life-history strategy. Hill, Boehm, and Prokosch (2016) examined the relationship between health history, the ability to delay gratification, and cognitive and behavioral proxies of life-history strategy measured using the short form of the Arizona Life History Battery (Mini-K; Figueredo et al. 2006). It was proposed that a single common factor, the K-Factor, underlies various life-history indicators, including an assortment of sexual, reproductive, parental, and social behaviors (Figueredo et al., 2005). The Arizona Life History Battery is a 199-item psychometric life-history measure that contains cognitive and behavioral indicators of human life history, such as altruism, quality of relationship with parents, social support from family and friends, and cognitive functions, including insight, planning, and control. The Mini-K is a short-from measure developed to assess a general higher-order life-history strategy without research participants' response burden. Hill et al. (2016) asked undergraduates about their history of vulnerability to illness, which consisted of seven items measuring self-reported health history on a 7-point scale. The correlation between vulnerability to disease and their Mini-K score was −.21, which supported the hypothesis that people whose immunocompetence is low choose a faster life-history strategy. The childhood socioeconomic status (SES) score, which assesses richness of the childhood environment, was also highly positively correlated (.23) with the Mini-K score. Childhood SES also negatively correlates with vulnerability to disease (−.37). Because the authors did not control for the effect of childhood SES, the partial correlation between vulnerability to disease and the Mini-K score was calculated here to be −.14.

As Hill et al. (2016) pointed out, the effects of vulnerability to disease on life-history strategy might be mediated by the internal model/perception of immunocompetence. They suggested that this perception could be assessed using the infectability subscale of

doi: 10.5178/lebs.2017.62
Received 09 October 2017.
Accepted 16 October 2017.
Published online 10 November 2017.

perceived vulnerability to disease, called Perceived Infectability (PVD-PI) (Duncan, Schaller, & Park, 2009). Infectious diseases have been a threat to fitness throughout human evolution. Duncan et al. (2009) developed a 15-item PVD to assess individual differences regarding concerns about the transmission of infectious diseases. The PVD consists of two subscales: the PVD-PI, which assesses beliefs about one's own susceptibility to infectious diseases, and Germ Aversion (PVD-GA), which assesses emotional discomfort in a context indicating a particularly high potential for pathogen transmission. The PVD-PI predicts behavioral immune responses rooted in a rational appraisal of susceptibility to infectious disease, which might affect life-history strategy.

The present study investigated the effects of the PVD-PI and PVD-GA scores on the Mini-K score in a large sample of females and males spanning a wide age range. A Japanese version of the PVD scale was developed by Fukukawa, Oda, Usami, and Kawahito (2014), and reliability and validity for each subscale indicated good results. The Mini-K scale was translated by Kawamoto (2015). In addition to these questionnaires, participants were asked about their current and future SES as well as their childhood SES. The results of Hill et al. (2016) predict that both the childhood SES and PVD-PI scores will significantly affect the Mini-K score.

Methods

Participants

A total of 1,200 Japanese adults (600 females and 600 males, mean age: 44.6 years, range: 30–59 years) were recruited through Cross Marketing, Inc. (Tokyo, Japan), a research agency that maintains a panel of more than 2,000,000 individuals who have agreed and consented to participate in web-based online surveys. Participants were recruited based on age to ensure an equal number of participants in each experimental group (200 females and 200 males in each age group: 30–39, 40–49, and 50–59 years).

Questionnaires

The participants were asked to complete the Japanese version of the 20-item Mini-K scale (Kawamoto, 2015). Then, the participants completed the Japanese version of the PVD scale (Fukukawa et al., 2014). Finally, their childhood and current/future SES scores were measured by asking them to indicate their agreement with statements on a 7-point scale with anchors from 1 (strongly disagree) to 7 (strongly agree). Childhood SES was measured with the following items: (a) "My family usually had enough money for things when I was growing up"; (b) "I grew up in a relatively wealthy neighborhood"; (c) "I felt relatively wealthy compared to the other kids in my school." Current/future SES was measured with the following items: (a) "I have enough money to buy things I want"; (b) "I don't need to worry too much about paying my bills"; (c) "I don't think I'll have to worry about money too much in the future." (Griskevicius, Tybur, Delton, & Robertson, 2011). These items were translated into Japanese by the author.

Data Analysis

A generalized linear model was used to analyze the effects of predictor variables on the Mini-K score. The predictor variables analyzed were sex (male: 1, female: 0), age (year), scores on the PVD subscales (PVD-PI and PVD-GA), and childhood SES and current/future SES scores.

Results and Discussion

Mean and standard deviation (*SD*) of the Mini-K scores was 0.21 ± 0.85 (male: 0.04 ± 0.83, female: 0.38 ± 0.84). Females tended to show a slower life-history strategy than males. The difference was significant but the effect size was small (t = 7.09, df = 1197.8, $p < .001$, Cohen's d = 0.41). Simple correlations among the factors were calculated (Table 1). The correlation between the PVD-PI and the Mini-K score was significant but weaker than the correlation between the vulnerability to disease and the Mini-K score in Hill et al. (2016) (−.08 vs. −.21). The partial correlation after controlling for childhood SES was −.06.

Table 1. Correlations between each parameter.

Parameter	2	3	4	5	6
1. Mini-K	.06*	.33***	.31***	−.08**	.02
2. Age		−.04	.02	−.04	−.01
3. Childhood SES			.46***	−.06*	.11***
4. Current/ future SES				−.10***	.02
5. Perceived Infectability					.11***
6. Germ Aversion					

* < .05, ** < .01, *** < .001

Generalized linear model analyses were performed, as there was no possibility of multicollinearity among the predictor variables. The first model included sex, age, childhood SES, and current/future SES. The Akaike Information Criterion (AIC) of the model was 2824 and the effects of all predictors were significant. Older participants tended to show a slower life-history strategy than younger participants. The effect of age did not correspond to the results of previous studies: Kawamoto (2015) reported that the age of his Japanese participants was not correlated with the Mini-K (r = −.04), which supported the results of a previous study (Figueredo et al., 2005). Early life stress and severity of current and future environments encouraged the participants to adopt a faster life-history strategy, which supports the findings of previous studies. Next, the PVD-PI and PVD-GA scores were added to the model. The AIC of the model decreased to 2823.2 but neither the PVD-PI nor the PVD-GA estimate was significant (Table 2). Incorporating the PVD-PI and PVD-GA scores into the model slightly increased the goodness of fit prediction, but the influence of these factors on life-history strategy was much weaker than that of the harshness of the socio-economic environment.

The weak effects of perceived vulnerability to disease on the K-factor may have been caused by the negative relationship between vulnerability to disease and short-term mating orientation, which characterizes a faster life-history strategy (Murray, Jones, & Schaller, 2013).

Table 2. Estimates of each predictor variable for the Mini-K score.

Parameter	Estimate	*SE*	*t*
Sex	−0.365	0.046	−7.91***
Age	0.008	0.003	2.83**
Childhood SES	0.050	0.006	7.85***
Current/future SES	0.043	0.006	7.14***
Perceived Infectability	−0.026	0.024	−1.06
Germ Aversion	−0.047	0.026	−1.76

** < .01, *** < .001

That is, more pathogen-avoidant individuals adopt more monogamous mating strategies because each new sexual partner increases the risk of exposure to novel pathogens via sexual intercourse or close physical contact, which might weaken the negative effect of PVD on the Mini-K score. Therefore, two items that asked about the long-term mating orientation tendency from the Mini-K scale were excluded: ("I would rather have one than several sexual relationships at a time"; "I have to be closely attached to someone before I am comfortable having sex with them") and investigated the effects of predictor variables on the new Mini-K score. Mean and SD of the excluded version were 0.13 ± 0.87 (male: 0.00 ± 0.85, female: 0.27 ± 0.87). Females tended to show slower life-history strategies than males. The difference was significant but the effect size was small ($t = 5.63$, $df = 1197.6$, $p < .001$, Cohen's $d = 0.33$). Simple correlations between the new Mini-K and age, childhood SES, current/future SES, PVD-PI, and PVD-GA were .05, .35, .34, −.08, and .01, respectively. These correlations were significant except for that with PVD-GA. The AIC of the model that included sex, age, childhood SES, and current/future SES was 2831.2, and the effects of all predictors were significant. The AIC of the model decreased to 2829.7 when the PVD-PI and PVD-GA scores were added, and the PVD-GA estimate was significant (Table 3). Participants who revealed higher germ aversion tended to show a faster life-history strategy. Although the simple correlation between PVD-GA and the Mini-K score was almost zero, the partial correlation after controlling for childhood SES score was −.04. The Mini-K score, from which items on mating orientation were excluded, indicates the tendency to plan and control, as well as the degree of social/family contact and support. That is, strong germ aversion was associated with a lack of planning and support from others. Fukukawa et al. (2014) reported that PVD-GA in Japanese undergraduates negatively correlates with agreeableness and positively correlates with neuroticism in the Big Five personality traits, which might lead to unstable interpersonal relationships.

Table 3. Estimates of each predictor variable for the Mini-K score excluding two items on long-term mating orientation.

Parameter	Estimate	*SE*	*t*
Sex	−0.294	0.046	−6.33***
Age	0.007	0.003	2.49*
Childhood SES	0.053	0.006	8.18***
Current/future SES	0.047	0.006	7.77***
Perceived Infectability	−0.024	0.025	−0.95
Germ Aversion	−0.054	0.027	−2.01*

* < .05, *** < .001

The PVD-PI did not affect the Mini-K score even when the two items on mating orientation were excluded, suggesting that a rational appraisal of the susceptibility to infectious disease does not predict life-history strategy in Japanese adults, which did not support the results of Hill et al. (2016). This discrepancy might be due to difference of subjects between the two studies. Hill et al. (2016) investigated undergraduates, whose age is mainly around twenty, while the present study employed wider range of people over thirty as subjects. Although variation of the Mini-K score could not be compared between the two studies because Hill et al. (2016) did not report the detailed results, the present study could estimate the variation of the K-Factor more adequately than the previous study because the present study focused on people in adulthood who are adequately able to have reproductive behaviors. The weak effect of perceived infectability on the life-history strategy in Japanese adults may have been due to the special environment of contemporary medical care in Japan, wherein medical standards are very high and the mortality rate is relatively low (GBD 2015 Healthcare Access and Quality Collaborators, 2017). Although vulnerability to infectious disease affects fitness, the perceived selective pressure would be very low in such an environment. Further study is needed to compare these results with those in countries that use different medical standards.

In the present study it was supposed that a participant's internal model/perception of immunocompetence had been formed by his/her history of vulnerability to illness and affected his/her life-history strategy. The negative results, however, lead to doubts validity of this premise. Indeed, although positive correlations between some psychological measures and the PVD scale were indicated, correlation with history of vulnerability to illness, which is a behavioral measure, was not examined in Japanese version (Fukukawa et al., 2014). Moreover, the PVD scale measures only explicit awareness of vulnerability. There is a possibility that perception of immunocompetence affects life-history strategy implicitly. It is a future task to clarify the link between one's history of vulnerability to illness and perception of it.

Acknowledgments

I thank an anonymous reviewer for helpful comments. This work was supported by JSPS KAKENHI Grant Number 15K04042.

References

Del Giudice, M., & Belsky, J. (2010). The development of life history strategies: toward a multistage theory. In D. M. Buss, & P. H. Hawley (Eds.), The evolution of personality and individual differences (pp. 154–176). New York: Oxford University Press.

Del Giudice, M., Ellis, B. J., & Shirtcliff, E. A. (2011). The adaptive calibration model of stress responsivity. Neuroscience & Biobehavioral Reviews, 35, 1562–1592. (doi: 10.1016/j.neubiorev.2010.11.007)

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: development and validation of a 15-item self-report instrument. Personality and Individual Differences, 47, 541–546. (doi: 10.1016/j.paid.2009.05.001)

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: the impact of harsh versus unpredictable environments on the evolution and development of life history strategies. Human Nature, 20, 204–268. (doi: 10.1007/s12110-009-9063-7)

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Sefcek, J. A., Kirsner, B. R., & Jacobs, W. J. (2005). The K-factor: individual differences in life history strategy. Personality and Individual Differences, 39, 1349–1360. (doi: 10.1016/j.paid.2005.06.009)

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M. R., Sefcek, J. A., Tal, I. R., . . . Jacobs, W. J. (2006). Consilience and life history theory: from genes to brain to reproductive strategy. Developmental Review, 26, 243–275. (doi: 10.1016/j.dr.2006.02.002)

Fukukawa, Y., Oda, R., Usami, H., & Kawahito, J. (2014). Development of a Japanese version of the perceived vulnerability to disease scale. Shinrigakukenkyu [The Japanese Journal of Psychology], 85, 188–195. (doi: 10.4992/jjpsy.85.13206) [in Japanese with English abstract]

GBD 2015 Healthcare Access and Quality Collaborators (2017). Healthcare access and quality index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015: a novel analysis from the Global Burden of Disease Study 2015. The Lancet, 390, 231–266. (doi: 10.1016/S0140-6736(17)30818-8)

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: a life history theory approach. Journal of Personality and Social Psychology, 100, 1015–1026. (doi: 10.1037/a0022403)

Hill, S. E., Boehm, G. W., & Prokosch, M. L. (2016). Vulnerability to disease as a predictor of faster life history strategies. Adaptive Human Behavior and Physiology, 2, 116–133. (doi: 10.1007/s40750-015-0040-6)

Kawamoto, T. (2015). The translation and validation of the Mini-K scale in Japanese. Japanese Psychological Research, 57, 254–267. (doi: 10.1111/jpr.12083)

Murray, D. R., Jones, D. N., & Schaller, M. (2013). Perceived threat of infectious disease and its implications for sexual attitudes. Personality and Individual Differences, 54, 103–108. (doi: 10.1016/j.paid.2012.08.021)

Pianka, E. R. (1970). On r- and K-selection. The American Naturalist, 104, 592–597. (doi: 10.1086/282697)