Article

Is Conscientiousness Always Associated With Better Health? A U.S.–Japan Cross-Cultural Examination of Biological Health Risk

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Abstract

In Western societies, conscientiousness is associated with better health. Here, we tested whether this pattern would extend to East Asian, collectivistic societies. In these societies, social obligation motivated by conscientiousness could be excessive and thus health-impairing. We tested this prediction using cross-cultural surveys of Americans (N = 1,054) and Japanese (N = 382). Biomarkers of inflammation (interleukin-6 and C-reactive protein) and cardiovascular malfunction (systolic blood pressure and total-to-HDL cholesterol ratio) were adopted to define biological health risk (BHR). Among Americans, conscientiousness was associated with lower BHR. Moreover, this relationship was mediated by healthy lifestyle. In contrast, among Japanese, the relationship between conscientiousness and BHR was not significant. Further analysis revealed, however, that conscientiousness was associated with a greater commitment to social obligation, which in turn predicted higher BHR. These findings suggest that conscientiousness may or may not be salubrious, depending on health implications of normatively sanctioned behaviors in varying cultures.

Keywords

culture, conscientiousness, biological health risk, healthy lifestyle, social obligation

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Conscientiousness refers to a global personality trait characterized by several facets, including industriousness, diligence, dutifulness, and perseverance (MacCann et al., 2009). A growing body of work shows that conscientiousness is a protective factor of health (Bogg & Roberts, 2004; Friedman & Kern, 2014; Israel et al., 2014). Importantly, the positive association between conscientiousness and health has been observed regardless of whether health is assessed subjectively by self-report or objectively with stress markers (Bogg & Slatcher, 2015; Nater et al., 2010), proinflammatory cytokines (Chapman et al., 2009; Luchetti et al., 2014), and mortality (Kern & Friedman, 2008). Conscientiousness is thought to contribute to better health in part because it lends itself to healthy lifestyles (Bogg & Roberts, 2004).

Nonetheless, most of the current evidence comes from Western societies. Hence, it remains unclear whether the link between conscientiousness and better health would generalize to other countries. In the current work, we tested whether health correlates of conscientiousness might vary between the United States and Japan by assessing biomarkers of inflammation and cardiovascular malfunction as an index of biological health risk (BHR; Hartanto et al., 2020; Kitayama et al., 2015, 2018; Park et al., 2019). We argue that conscientious people work hard in a norm-congruous fashion. However, cultures vary in what norms are prioritized and institutionalized. Hence, there may be a systematic cultural variation in the health correlates of conscientiousness, depending on the health implications of normatively sanctioned behaviors in varying cultures.

One key dimension that underlies cultural variation in norms is the dimension of independence versus interdependence of the self. Markus and Kitayama (1991) have proposed that the sense of the self as independent is strongly upheld in individualistic, Western societies. People engaged in these individualistic cultures tend to place a higher priority on personal goals over societal expectations (Morling et al.,

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2002). As may be expected, their happiness depends on the achievement of such goals to a greater extent than on the realization of social harmony or connectedness (Uchida & Kitayama, 2009). Given the emphasis on independence of the self, we may expect that people engaged in Western, individualistic cultures will seek to maintain wellbeing of the personal self, including both mental health (e.g., being happy) and its physical counterpart (e.g., being physically fit). Helping themselves would be seen as a signature marker of a "responsible" person—that is, someone who is both autonomous and capable of contributing to the society. It stands to reason, then, that the more conscientious individuals are, the more devoted they will be to promote their health, both physical and mental, by pursuing healthy lifestyles (Bogg & Roberts, 2004).

In contrast, in many non-Western cultures, including East Asian societies, such as Japan, Korea, and China, the sense of the self as interdependent with others is more strongly endorsed (Markus & Kitayama, 1991). People in these collectivistic cultures prioritize social duties and obligations over their personal goals (Morling et al., 2002). As may be expected, their happiness depends more on social harmony than on personal achievement (Uchida & Kitayama, 2009). For Asians then, obligations to meet others' expectations carry utmost significance and thus likely override many of the concerns over personal welfare and wellbeing (Miller & Bersoff, 1992). From the hypothesis that the role of social obligation is paramount among Asians, it would follow, first, that the link between conscientiousness and healthy lifestyle might not be as strong in Asia as it is in Western populations. Second, we may also predict that conscientiousness should be related more strongly to devotion to social (rather than personal) welfare, that is, to the welfare of the pertinent social unit in general and to obligations and duties instituted therein. Furthermore, this social devotion can become excessive because of the relative neglect of the personal welfare in such cultural contexts. Consistent with this view, a recent analysis has shown that social obligations at work and family, in combination, predict poor biological health profiles among Japanese, but not among Americans (Hartanto et al., 2020). Thus, in the current work, we tested whether conscientiousness might be linked to poor biological health through social obligation in Japanese. That is, there might be an adverse health effect of conscientiousness because of its association with social obligation, which proves to have adverse health effects in Japan.

A handful of studies examined health correlates of conscientiousness in East Asian samples, but the findings so far are inconclusive. One study found that conscientiousness is associated with lower adiposity among Koreans (Shim et al., 2014). However, this same association has not been observed in another study based on larger samples of Chinese, Japanese, and Taiwanese (Sutin et al., 2015). Another study showed that conscientiousness is associated with reduced smoking in Japanese (Abe et al., 2019), but this study did not test other health-relevant behaviors. One study by Iwasa et al. (2008) showed that mortality rate is lower for those high in conscientiousness in a community sample of Japanese. However, this study did not control for education or other socioeconomic status markers that are related to both high conscientiousness (Ozer & Benet-Martínez, 2006) and lower mortality (Brown et al., 2012). Hence, the salubrious effect of conscientiousness in Japan could be more apparent than real. Most importantly, so far, no study tested biomarkers of inflammation or cardiovascular malfunction, our primary health outcomes.

We tested our predictions by using parallel population-level surveys conducted in both the United States (Midlife in the United States, MIDUS) and Japan (Midlife in Japan, MIDJA). Following prior work (Hartanto et al., 2020; Kitayama et al., 2015, 2018; Park et al., 2019), we focused on a composite of two biomarkers of inflammation (interleukin-6 [IL-6] and C-reactive protein [CRP]) and two biomarkers of cardiovascular malfunction (systolic blood pressure [SBP] and the ratio of total-to-HDL cholesterol [T/HDL cholesterol]), called BHR. We analyzed BHR as a function of both culture and conscientiousness while controlling for a set of demographic variables that have been shown to predict BHR. We further tested healthy lifestyle and devotion to social obligation as mediators of the link between conscientiousness and BHR for Americans and Japanese, respectively. Our analysis is cross-sectional and thus it is premature to infer causal effects from it. Nevertheless, the correlational patterns revealed in the mediation analyses can inform the validity of the current analysis.

Method

Participants

The American data were drawn from the MIDUS survey, which was initiated in 1995 based on a nationally representative sample of English-speaking adults (MIDUS I; N = 7,108; Brim et al., 2004). A follow-up survey session was conducted from 2004 to 2006 (MIDUS II; N = 4,963; retention rate = 75%), in which our key survey measures (i.e., conscientiousness, social obligation, and healthy lifestyle) were administered. A subsample of the MIDUS II participants provided a blood sample for biomarker assays during an overnight session at one of three General Clinical Research Centers (Madison, WI, Washington, DC, or Los Angeles, CA; N = 1,054; 578 females, M_{age} = 58.04, SD_{age} = 11.62, age range = 35–86), which took place between 2005 and 2009.[1] The Japanese data were drawn from a parallel survey conducted in Japan, called the MIDJA survey. The first wave of this survey was conducted from 2008 to 2009, based on 1,027 adults randomly recruited from the Tokyo metropolitan area (522 females, M_{age} = 54.36, SD_{age} = 14.15). The present analysis used a subsample of these participants who provided biological data at a medical clinic near the University of Tokyo between 2009 and 2010 (N = 382; 214

females; M_{age} = 55.47, SD_{age} = 14.04, age range = 31–80). For both cultural groups, the interval between the survey session and biomarker data collection was less than 3 years.

As the present work is a secondary analysis of archival data (which is available at https://www.icpsr.umich.edu/icpsrweb/), we had no control over the sampling strategy or sample size. A sensitivity power analysis using G*Power (version 3.1; Faul et al., 2009) showed that there was 80% power in detecting the interaction between culture and conscientiousness in predicting BHR based on the current sample size (N = 1,436) with a small effect size (f^2 = .01; α = .05, two-tailed).

Measures

BHR. A composite index of BHR is comprised of two biomarkers of pro-inflammatory cytokines (IL-6 and CRP) and two biomarkers of cardiovascular malfunction (SBP and T/HDL cholesterol). Blood samples were taken during the biomarker session for the assays of IL-6, CRP, and cholesterol. For IL-6 and CRP assays, frozen serum and plasma samples from both countries were shipped to Biocore Laboratory at the University of Wisconsin, Madison, WI. Serum IL-6 levels were then assayed using the high-sensitivity enzyme-linked immunosorbent assay (ELISA) method (Quantikine, R&D Systems, Minneapolis, MN), with a lower sensitivity of detection at 0.16 pg/mL. Plasma CRP levels were determined using BNII immunonephelometry (BNII Nephelometer 100 Analyzer; Dade Behring Inc., Deerfield, IL, USA). The total and HDL cholesterol were assayed at a separate testing laboratory in each country, that is, at Meriter Labs (Madison, WI) in the United States and at Showa Medical Science in Japan. Blood pressure recordings were obtained at the clinic by clinic staff. After a 5-min resting period, blood pressure was recorded three times, with 30-s intervals between recordings. Two most similar recordings were then averaged to create a single index of SBP.

Following the standard procedure in MIDUS and MIDJA (Coe et al., 2011; Kitayama et al., 2015, 2018; Miyamoto et al., 2013; Park et al., 2019), we adjusted a small number of extreme values on each biomarker using winsorization and then log-transformed the winsorized variables to normalize their distributions (see the "Data Processing and Analytic Strategies" section below for more information). The four biomarkers were significantly correlated with one another for both cultural groups, resulting in a single factor based on the principal component analysis (PCA), which accounted for 41.4% and 50.1% of the variance for Americans and Japanese, respectively. Following the procedure used in prior work (Kitayama et al., 2015, 2018; Park et al., 2019), the factor score obtained from the PCA based on the total sample was used as an index of BHR.

Self-rated health. To examine whether the relationship between conscientiousness and subjective health is also moderated by culture, we assessed subjective health with a single-item measure of self-rated health (Prenda & Lachman, 2001). Participants were asked to rate their health these days using a scale from 0 (*worst possible health*) to 10 (*best possible health*).

Conscientiousness. Conscientiousness was assessed with the Midlife Development Inventory (MIDI) Personality Scale (Lachman & Weaver, 1997). Participants rated the extent to which each of five self-descriptive adjectives described them using a 4-point scale (1 = *not at all*, 4 = *a lot*; αs = .70 and .67 for Americans and Japanese, respectively). This scale tapped on diligence (hardworking, thorough, careless [reverse-coded]) and dutifulness (organized, responsible), two of major facets of conscientiousness (Chopik, 2016; Roberts et al., 2005). Although social obligation is sometimes theorized to be part of conscientiousness (Bogg & Roberts, 2004; Roberts et al., 2005), the current measurement does not directly tap social obligation. We used confirmatory factor analysis (CFA) to ensure the measurement equivalence of this scale in the two cultural groups (see Supplemental Methods).

Mediating variables. As potential mediators of the link between conscientiousness and BHR, we examined (a) healthy lifestyle, operationalized as the degree to which participants engage in healthy behaviors or avoid unhealthy behaviors and (b) social obligation, operationalized as self-rated moral commitment to social responsibilities.

Healthy lifestyle. Based on the health behavioral model of personality which posits that the ultimate health impact of personality traits is mediated in part by certain healthy (or unhealthy) behaviors they promote (or inhibit; Friedman, 2000), we assessed five indices of health-relevant behaviors, including (a) current smoking status, (b) alcohol consumption, (c) unhealthy eating, (d) physical inactivity, and (e) poor sleep quality.

Participants' current smoking status was assessed with a dummy-coded variable (0 = *non-smoking*, 1 = *smoking*). Alcohol consumption was operationalized as the average number of alcohol drinks participants consumed per week. The amount of daily consumption of sugared beverages (1 = *none*, 5 = *seven or more glasses per day*) and weekly consumptions of high-fat meat (1 = *never*, 5 = *five or more per week*) and fast food (1 = *never*, 5 = *seven or more per week*) were averaged to create an index of unhealthy eating. Physical activity was assessed using an item included in the 48-item Positive Events Scale (MacPhillamy et al., 1982). Participants rated how often over the past month they spent time having good fitness workout (1 = *never*, 3 = *more than seven times*). The scores were reverse-coded such that higher numbers indicate physical inactivity. Sleep quality was assessed with the 19-item Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), which included seven subscales (subjective sleep

quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction). The scores across these subscales were summated to create a global index, ranging from 0 to 21, with higher numbers indicating poor quality of sleep. These five indices of unhealthy behaviors were standardized, summated, and then multiplied by −1 so that higher numbers indicate healthier lifestyle defined by the propensities to avoid unhealthy behaviors and/or to engage in healthy behaviors.

Social obligation. The propensity to perform behaviors designed to address expectations and responsibilities in two types of ingroups—family/friends and work—was assessed with the social obligation scale (Rossi, 2001). Using a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*), participants rated the extent to which they respond to needs and expectations of both family/friends (four items; for example, "I feel obligated to contact family members on a regular basis," "I feel obligated to give money to a friend in need, even if this makes it hard to meet my own needs") and members in their work group (three items; for example, "I am the one to volunteer to do unwanted tasks at work," "I help out my colleagues/coworkers at work"). The scores from these items were averaged to create an index of social obligation (αs = .65 and .68 for Americans and Japanese, respectively). Further analysis confirmed the measurement equivalence of this construct across the two cultural groups (see Supplemental Methods).

Covariates. We controlled for a set of variables that could influence the relationship between conscientiousness and BHR, including gender, age, and social status (objective and subjective), which are strong predictors of both inflammation and cardiovascular malfunction (Coe et al., 2011; Kitayama et al., 2015). Building on prior evidence that the two types of social status (objective and subjective) have different health impact across cultures (Curhan et al., 2014), we controlled for both in the present analysis. Objective social status was assessed by educational attainment. Reflecting cultural differences in the educational system, education was assessed using different scales, ranging from 1 (*8th grade, junior high school*) to 12 (*PhD or other professional degree*) in the United States and from 1 (*8th grade, junior high school graduate*) to 8 (*graduate school*) in Japan. Following Park et al. (2013), we rescaled the values using a 7-point scale (1 = *8th grade, junior high school*, 7 = *attended or graduate from graduate school*) to make them comparable for both cultural groups. To assess subjective social status, participants were asked to rank themselves on a "social ladder" with 10 rungs (1 = *lowest*, 10 = *highest*) to indicate their relative standing in their community (Adler & Ostrove, 1999).

Data Processing and Analytic Strategies

Before data analysis, we first identified extreme values in health-relevant variables using a criterion based on the standard procedure from MIDUS and MIDJA (Coe et al., 2011; Kitayama et al., 2015, 2018; Miyamoto et al., 2013; Park et al., 2019). A small number of outliers in all four biomarkers (ns < 29) and alcohol consumption (n = 29) were winsorized at three standard deviations from the mean in each culture. As noted above, all four biomarkers were then log-transformed as these variables did not follow normal distributions.

The first aim of the current work was to examine whether the relationship between conscientiousness and BHR is moderated by culture (Aim 1). We then examined possible mediators for the culturally divergent relationships between conscientiousness and BHR (Aim 2). We tested both healthy lifestyle and social obligation as potential mediators using Hayes' PROCESS macro, with 2,000 bias-corrected bootstrapping samples. We tested each of these two proposed mediating mechanisms separately first. We then conducted a combined analysis to test both variables as simultaneous mediators to examine their independent effects (see below for more details for each model). Finally, we tested the link between conscientiousness and self-rated health across two cultural groups to examine whether the hypothesized cultural difference is specific to biomarkers of health or generalizable to subjective health (Aim 3). In all analyses, we included gender, age, and two indices of social status (objective and subjective) as covariates to adjust for their effects. All analyses were conducted using SPSS software (Version 23).

Results

Descriptive statistics and intercorrelations for key study variables are presented in Tables 1 and 2, respectively. As shown in previous analyses (Coe et al., 2011), the two cultural groups differed in the composite index of BHR, $t(1,417) = 20.61$, $p < .001$, $d = 1.20$, with Americans having higher BHR scores than Japanese. Americans also showed higher levels of healthy lifestyle than Japanese, $t(1,434) = 3.49$, $p < .001$, $d = 0.20$. Finally, for all indices of subjective self-judgments, including conscientiousness, self-rated health, and social obligation, the means were significantly higher for Americans than for Japanese, ts > 8.17, ps < .001, ds > 0.49, likely due to a positivity bias that is known to be stronger for Americans than for Japanese (Heine et al., 1999). As shown in Table 2, BHR and self-rated health were negatively correlated among Americans, $r(1,036) = -.22$, $p < .001$, but not among Japanese, $r(382) = -.08$, $p = .136$.

Aim 1: Culture as a Moderator of the Link Between Conscientiousness and BHR

Replicating previous evidence, and as shown in Figure 1, Americans showed a negative association between conscientiousness and BHR, $b = -.157$, 95% confidence interval [CI] = [−.270, −.044], $t(1,380) = -2.72$, $p = .007$. In contrast, there was no such relationship among Japanese, $b = .130$,

Table 1. Descriptive Statistics for Study Variables for Two Cultural Groups.

	Americans (N = 1,054)			Japanese (N = 382)			Cultural differences	
Variable	*N*	*M*	*SD*	*N*	*M*	*SD*	Statistics	*p*
Demographic variables								
Gender (% female)	578	54.8%		214	56.0%		$\chi^2(1) = .16$	.691
Age	1,054	58.04	11.62	382	55.47	14.04	$t(1,434) = 3.50$	<.001
Objective social status (education)	1,050	4.97	1.61	378	4.38	1.63	$t(1,426) = 6.11$	<.001
Subjective social status (social ladder)	1,042	6.59	1.72	374	6.24	2.04	$t(1,414) = 3.23$	.001
Conscientiousness	1,050	3.40	0.45	381	2.65	0.55	$t(1,429) = 26.14$	<.001
Healthy lifestyle	1,054	0.14	2.43	382	−0.39	2.77	$t(1,434) = 3.49$	<.001
Smoking status (% yes)	112	10.6%		82	21.5%		$\chi^2(1) = 34.53$	<.001
Alcohol consumption	1,052	2.99	4.78	379	6.96	9.66	$t(1,429) = -10.29$	<.001
Unhealthy eating	1,053	2.32	0.69	374	2.12	0.58	$t(1,425) = 4.98$	<.001
Physical inactivity	1,049	2.05	0.81	365	2.09	0.70	$t(1,414) = -.82$	.415
Poor sleep quality (PSQI global score)	999	5.92	3.46	295	5.26	2.60	$t(1,292) = 3.03$	.003
Social obligation	1,052	5.13	0.77	370	4.75	0.77	$t(1,420) = 8.17$	<.001
Biological health risk (BHR)	1,037	0.29	0.84	382	−0.79	0.96	$t(1,417) = 20.61$	<.001
Interleukin-6 (IL-6; pg/ML)	1,044	2.66	2.17	382	1.55	1.56	$t(1,424) = 9.18$	<.001
IL-6 (log-transformed)	1,044	0.31	0.31	382	0.04	0.36	$t(1,424) = 14.38$	<.001
C-reactive protein (CRP; ug/mL)	1,040	2.50	3.00	382	0.67	1.17	$t(1,420) = 11.59$	<.001
CRP (log-transformed)	1,040	0.14	0.49	382	−0.45	0.42	$t(1,420) = 20.95$	<.001
Systolic blood pressure (SBP; mmHg)	1,053	130.99	17.80	382	121.48	19.29	$t(1,433) = 8.74$	<.001
SBP (log-transformed)	1,053	2.11	0.06	382	2.08	0.07	$t(1,433) = 9.25$	<.001
Total-to-HDL cholesterol ratio (T/HDL cholesterol)	1,043	3.73	1.34	382	3.13	1.09	$t(1,423) = 7.85$	<.001
T/HDL cholesterol (log-transformed)	1,043	0.55	0.15	382	0.47	0.14	$t(1,423) = 8.36$	<.001
Self-rated health	1,053	7.58	1.46	382	6.43	1.82	$t(1,433) = 12.28$	<.001

Note. The extreme values on alcohol consumption, IL-6, CRP, SBP, and T/HDL cholesterol were winsorized at ±3 standard deviations from their mean in each culture.

95% CI = [−.022, .283], $t(1,380) = 1.68$, $p = .094$. The Culture × Conscientiousness interaction effect was statistically significant, $b = .287$, 95% CI = [.099, .475], $t(1,380) = 3.00$, $p = .003$ (see Table 3).[2] When we tested each of the four biomarkers that comprised the BHR measure separately, a similar interaction pattern was found for all of them (see Supplemental Figure S2), although the interaction did not reach statistical significance for CRP and SBP (see Supplemental Table S2 for regression results), and one specific comparison was not in the expected direction (i.e., the effect of conscientiousness on SBP for Americans).

Aim 2: Mediation Analyses

Healthy lifestyle. We tested whether the relationship between conscientiousness and reduced BHR, observed in the American sample, would be mediated by healthy lifestyle. This mediation was expected to be absent in Japanese, who would show little or no association between conscientiousness and healthy lifestyle. This analysis implies a moderated mediation in which the role of healthy lifestyle (proposed mediator) to mediate the relationship between conscientiousness (predictor) and BHR (outcome variable) is dependent on culture (moderator; Hayes, 2013). We formally tested this model using the Hayes' PROCESS Model 8, in which the link from conscientiousness to healthy lifestyle was hypothesized to be moderated by culture. This analysis showed that the mediating path was statistically significant among Americans, 95% bootstrapping CI = [−.104, −.046]. Conscientiousness was associated with greater engagement in healthy lifestyle, which in turn was associated with lower BHR (see Figure 2A for statistics). In contrast, there was no such mediation among Japanese because conscientiousness was not associated with healthy lifestyle, 95% bootstrapping CI = [−.043, .035]. As implied by this cultural difference, the moderated mediation model was statistically significant, Hayes Index = .069, 95% bootstrapping CI = [.022, .117].[3]

Social obligation. We next tested a comparable mediation of the link between conscientiousness and BHR by social obligation. The association between conscientiousness and BHR was not statistically significant among Japanese (see Figure 1). However, it has been established through simulations that much greater statistical power is required to detect the total effect (conscientiousness → BHR) than to detect the indirect paths assumed to account for the total effect (conscientiousness → social obligation → BHR; Kenny & Judd, 2014; Rucker et al., 2011). Because of this simulation

Table 2. Intercorrelations Among The Key Variables for Americans, Japanese, and Total Sample.

Americans		1	2	3	4	5	6	7	8	9
1.	Gender	—	−.05	−.08**	−.12***	.11***	.14***	−.03	−.07*	.01
2.	Age			−.07*	.18***	.00	.14***	.00	.17***	.07*
3.	Objective social status				.20***	.03	.20***	.08*	−.16***	.11***
4.	Subjective social status					.18***	.20***	.13***	−.07*	.25***
5.	Conscientiousness						.22***	.13***	−.11***	.22***
6.	Healthy lifestyle							.08*	−.27***	.31***
7.	Social obligation								−.06*	.07*
8.	Biological health risk									−.22***
9.	Self-rated health									—
Japanese		1	2	3	4	5	6	7	8	9
1.	Gender	—	−.08	−.11*	−.17***	−.04	.35***	−.03	−.37***	.07
2.	Age			−.35***	.10*	.14**	.24***	.20***	.50***	.04
3.	Objective social status				.12*	.13*	−.05	.09†	−.20***	.06
4.	Subjective social status					.25***	.01	.20***	.11*	.20***
5.	Conscientiousness						.07	.24***	.09†	.15**
6.	Healthy lifestyle							.09†	−.15**	.17***
7.	Social obligation								.16**	.09
8.	Biological health risk									−.08
9.	Self-rated health									—
Total sample		1	2	3	4	5	6	7	8	9
1.	Gender	—	−.06*	−.09***	−.14***	.05†	.20***	−.03	−.15***	.02
2.	Age			−.14***	.16***	.09***	.18***	.08**	.29***	.08**
3.	Objective social status				.19***	.14***	.14***	.11***	−.07**	.13***
4.	Subjective social status					.22***	.15***	.17***	.04	.25***
5.	Conscientiousness						.19***	.25***	.24***	.33***
6.	Healthy lifestyle							.10***	−.15***	.27***
7.	Social obligation								.11***	.13***
8.	Biological health risk									.01
9.	Self-rated health									—

†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

evidence, there is a consensus that a significant total effect is not a necessary condition for a mediation to occur (Shrout & Bolger, 2002). Thus, we tested whether the proposed mediating effect of social obligation on the association between conscientiousness and BHR is significant among Japanese, but not among Americans.

We have hypothesized that individuals high in conscientiousness would engage in behaviors addressing social obligation more. This devotion, however, was expected to be excessive and thus to be linked to increased BHR especially in Japan. This analysis implies a moderated mediation model in which the link from social obligation to BHR is moderated by culture. We tested this model using Hayes' PROCESS Model 15. As predicted, the mediating path (conscientiousness → social obligation → increased BHR) was significant among Japanese, 95% bootstrapping CI = [.007, .073]. As shown in Figure 2B, conscientiousness was associated with increased levels of social obligation, which in turn were associated with increases in BHR. The same mediation was statistically negligible among Americans because social obligation did not predict their BHR, 95% bootstrapping CI = [−.034, .006]. Consistent with the cultural difference in the magnitude of this mediation, the moderated mediation model was statistically significant, Hayes Index = .050, 95% bootstrapping CI = [.014, .093].[4]

Combined analysis. Are the two moderated mediation paths identified above independent of one another? To address this question, we performed a combined analysis. Both moderated mediation paths from conscientiousness to BHR were simultaneously estimated using PROCESS Model 59. Consistent with the results described above, the mediating effect of healthy lifestyle was significant among Americans, 95% bootstrapping CI = [−.120, −.049], but not among Japanese, 95% bootstrapping CI = [−.036, .031], resulting in a significant moderated mediation, Hayes Index = .077, 95% bootstrapping CI = [.032, .129]. In contrast, the second mediating path involving social obligation was

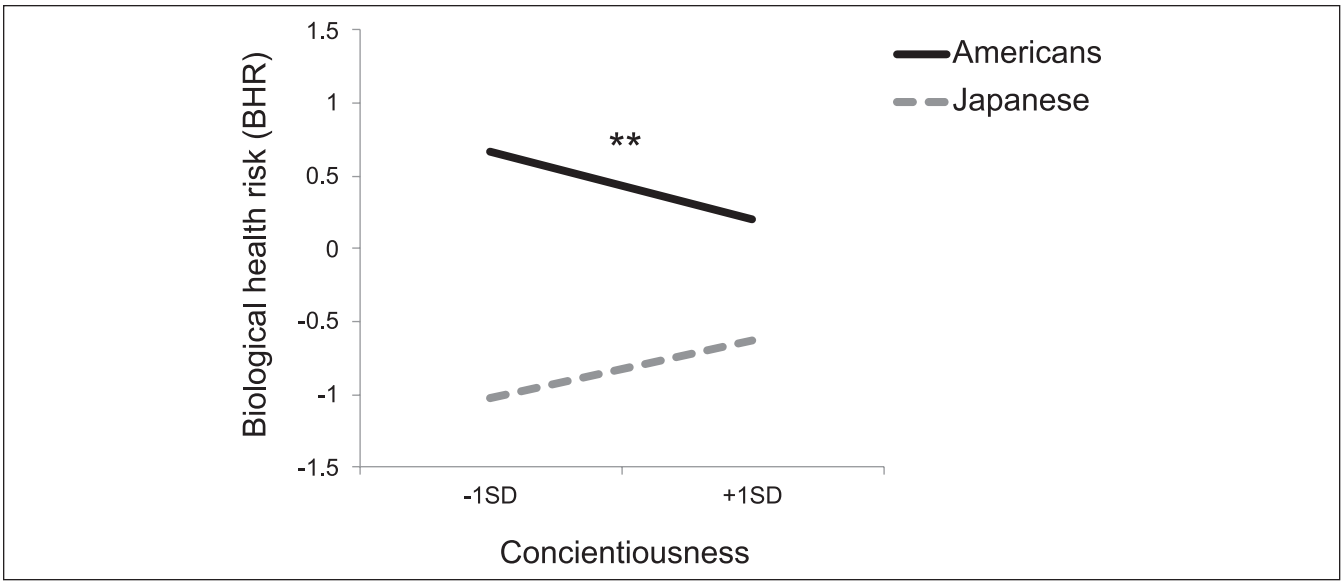

Figure 1. Biological health risk (BHR) as a function of conscientiousness for Americans (solid line) and Japanese (dotted line).
Note. Gender, age, and objective and subjective social status are controlled. Statistical significance is indicated by asterisk.
**$p < .01$.

Table 3. Regression Coefficients in Predicting Biological Health Risk and Self-Rated Health as a Function of Culture and Conscientiousness.

Biological health risk	*b*	*t*-test	
Gender	−0.282	−6.29	***
Age	0.018	9.75	***
Objective social status	−0.079	−5.60	***
Subjective social status	−0.019	−1.49	
Conscientiousness	−0.157	−2.72	**
Culture	−1.063	−16.08	***
Culture × Conscientiousness	0.287	3.00	**
Self-rated health	***B***	***t*-test**	
Gender	0.147	1.79	†
Age	0.005	1.34	
Objective social status	0.053	2.06	*
Subjective social status	0.167	7.13	***
Conscientiousness	0.550	5.20	***
Culture	−0.745	−6.10	***
Culture × Conscientiousness	−0.207	−1.17	

Note. *N*s = 1,388 and 1,403 for the analysis on biological health risk and self-rated health, respectively. Conscientiousness was centered before computing the interaction term (Culture × Conscientiousness).
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

significant among Japanese, 95% bootstrapping CI = [.008, .081], but not among Americans, 95% bootstrapping CI = [−.024, .004]. As implied by this pattern, the moderated mediation was significant, Hayes Index = .040, 95% bootstrapping CI = [.011, .087].

Aim 3: Self-Rated Health

We also tested the link between conscientiousness and self-rated health. Unlike in the analysis on BHR, conscientiousness was predictive of better health in both Americans and Japanese, as indicated by a significant main effect of conscientiousness, $b = .550$, 95% CI = [.342, .757], $t(1395) = 5.20$, $p < .001$. The Culture × Conscientiousness interaction effect was statistically negligible, $b = -.207$, 95% CI = [−.553, .139], $t(1395) = -1.17$, $p = .241$. See Table 3 for full regression results.

Although culture did not moderate the relationship between conscientiousness and self-rated health, we conducted the same set of mediation analyses to examine whether healthy lifestyle and social obligation, either as a separate mediator or as simultaneous mediators, accounted for the significant relationship between conscientiousness and better subjective health observed for both cultural groups. First, when health lifestyle was tested as a single mediator (i.e., conscientiousness → healthy lifestyle → self-rated health), its effect was significant among Americans, 95% bootstrapping CI = [.076, .192], but not among Japanese, 95% bootstrapping CI = [−.055, .074], which resulted in a significant moderated mediation, Hayes Index = −.117, 95% bootstrapping CI = [−.211, −.043]. In contrast, there was no evidence that social obligation mediated the effect of conscientiousness on subjective health for both cultural groups (i.e., conscientiousness → social obligation → self-rated health), 95% bootstrapping CI = [−.027, .040] for Americans and [−.039, .121] for Japanese. The moderated mediation was not significant, Hayes Index = .026, 95% bootstrapping CI = [−.056, .123].

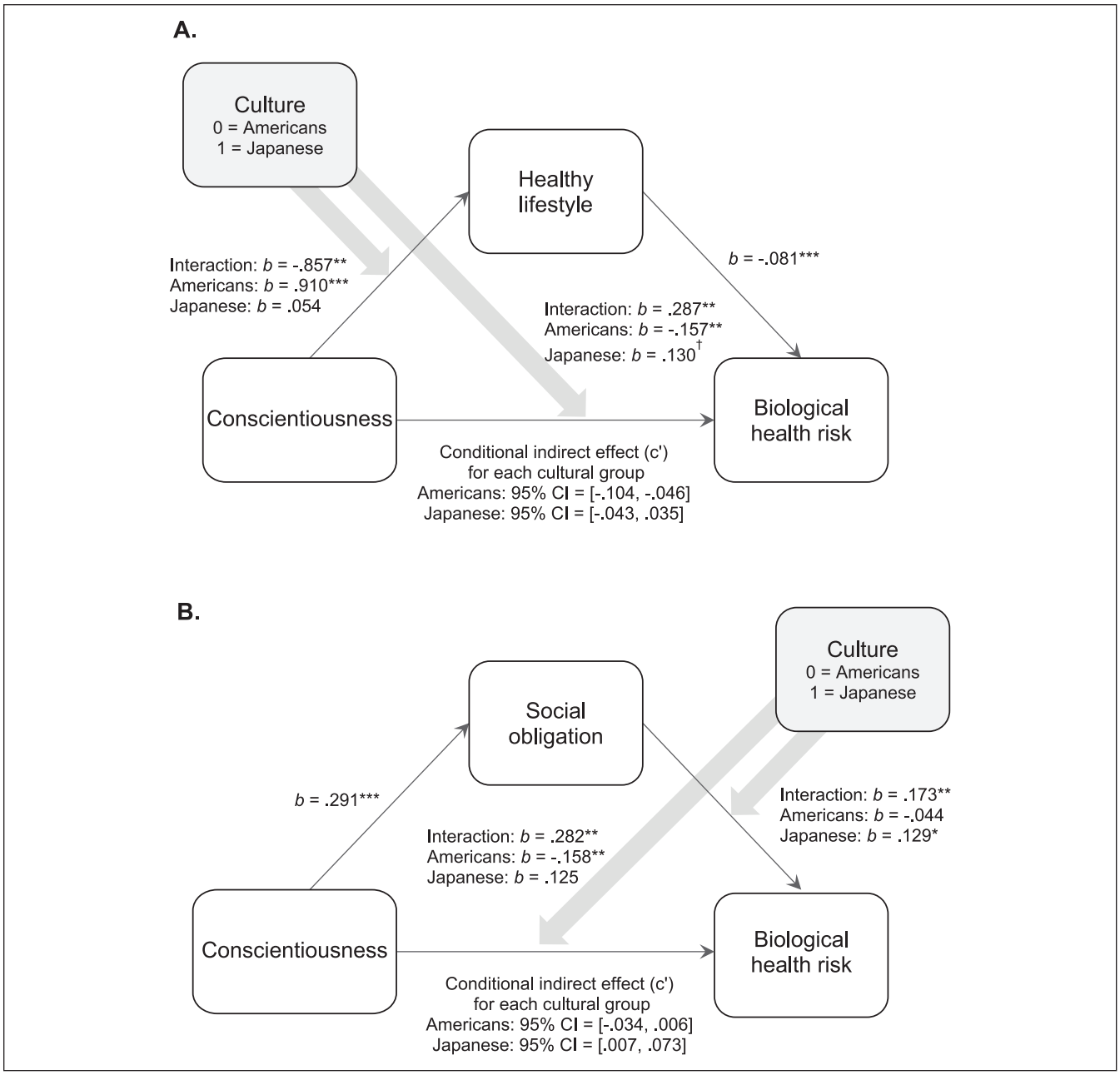

Figure 2. (A) A moderated mediation model in which the mediating effect of healthy lifestyle was significant among Americans, but not among Japanese. (B) A moderated mediation model in which the mediating effect of social obligation was significant among Japanese, but not among Americans.

Note. Unstandardized coefficients are shown. The values in square brackets are 95% confidence intervals (CIs) from a bootstrap test with 2,000 replications. Gender, age, and objective and subjective social status are controlled. Statistical significance is indicated by asterisk.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

When we conducted a combined analysis that tested healthy lifestyle and social obligation as simultaneous mediators, the analysis yielded similar results. The mediating effect of healthy lifestyle was significantly moderated by culture, Hayes Index = −.126, 95% bootstrapping CI = [−.211, −.052], such that the mediating path was significant only for Americans, 95% bootstrapping CI = [.079, .200], but not for Japanese, 95% bootstrapping CI = [−.052, .065]. In contrast, the mediating effect of social obligation was statistically negligible for both cultural groups, 95% bootstrapping CI = [−.022, .025] for Americans and [−.036, .101] for Japanese, resulting in a non-significant moderated mediation, Hayes Index = .026, 95% bootstrapping CI = [−.043, .101].

Discussion

Culture, Conscientiousness, and Biological Health

Prior work based on Western populations established that conscientiousness is healthy, linked to both better biological health and greater longevity (Kern & Friedman, 2008; Luchetti et al., 2014). This pattern of data lends support to the hypothesis that conscientious people engage in health-promoting lifestyle while avoiding health-compromising lifestyle, which in turn leads to salubrious outcomes (Bogg & Roberts, 2004). Our analysis of the American data provided support to this hypothesis.

As noted earlier, a handful of prior studies based on East Asian populations proved inconclusive (Abe et al., 2019; Iwasa et al., 2008; Shim et al., 2014; Sutin et al., 2015). Moreover, none of these studies tested biomarkers of inflammation or cardiovascular malfunction. Our Japanese sample, therefore, was the first test of whether conscientiousness might be linked to BHR. Of note, we found no evidence for any direct association between conscientiousness and biological health. However, further analysis on the mediational paths suggested that in the Japanese sample, conscientiousness predicted not healthy lifestyle, but the devotion to social obligation, which in turn, was associated with compromised biological health. These findings are consistent with the hypothesis that the more conscientious people are, the likelier it is that they engage in norm-congruous behaviors, including social duties and obligations.

Existing evidence suggests that in collectivistic societies, the demand for obligation is tightly sanctioned. For example, norms are more rigid in such societies as compared with Western democracies including the United States (Gelfand et al., 2011). Our work suggests that this demand may be strong to the point where it can compromise biological health in Japan. Of note, conscientiousness was equally associated with increased sense of social obligation regardless of culture. Yet, only among Japanese, this sense of social obligation was associated with compromised biological health. Although our Japanese data did not show any significant direct link between conscientiousness and BHR, the results from the mediational analysis are consistent with the hypothesis that conscientiousness could be linked to compromised biological health through indirect effects of social obligation.

Healthy Lifestyle

Yet another important contribution of our work stems from the extensive measure we adopted to assess healthy lifestyle. In addition to current smoking status, our measure included four additional health-relevant behaviors, namely, alcohol consumption, unhealthy eating, physical inactivity, and poor sleep quality. It is of note that by using this comprehensive measure of healthy lifestyle, we show clear evidence that conscientiousness is associated with healthy lifestyle among Americans, but not among Japanese. Note that prior work showed that conscientiousness could be linked to one or another of healthy behaviors even among Japanese (e.g., smoking status; Iwasa et al., 2008). However, this association was not replicated in the current MIDJA sample. Although conscientiousness was associated with less smoking among Americans in MIDUS, but not among Japanese in MIDJA (see Supplemental Figure S5).

The significant interaction between culture and conscientiousness on healthy lifestyle is theoretically important since the currently dominant interpretation of the positive association between conscientiousness and health is based on the premise that conscientiousness promotes healthy lifestyle (e.g., Bogg & Roberts, 2004). This theoretical account must be reconsidered, not as a universal statement, but rather as a statement that is contingent on the sociocultural context that promotes the norms of prioritizing personal wellbeing and health, such as the American culture. One could say that these norms represent the ultimate ideal of individualism, insofar as the wellbeing of each individual is conceptualized as a founding stone of society.

Social Obligation

As important, our measure of social obligation was also extensive, with a focus on both work- and family-related matters. Our data provide initial evidence that there might be a negative effect of conscientiousness on biological health in Japanese, consistent with the notion that conscientiousness could be unhealthy in some cultural contexts because it is associated with overcommitment to duties at either work or home. It is noteworthy that among Americans, conscientiousness was also associated with social obligation, but just because one engages in social obligation had nothing to do with biological health. A recent analysis also used the same dataset and reported the adverse effect of social obligation on BHR in Japan, but not in the United States (Hartanto et al., 2020). This cultural difference is consistent with the idea that social obligation is a moral imperative that overrides concerns over personal welfare among Asians, including Japanese. Indeed, the analysis offered by Hartanto et al. (2020) suggests that the adverse health effect of social obligation is particularly serious for Japanese who would readily give up their personal goals in the presence of pending social obligations. Hence, the East Asian form of interdependence, with a strong emphasis on social obligations, is a double-edged sword. Although it is the basis for social harmony, it can also undermine one's health. The benefit of this interdependence at the cultural level (i.e., social harmony) appears to override its cost at the personal level (i.e., BHR). Indeed, the resulting equation favoring the collective over the personal would qualify an ultimate form of collectivism.

Our data also suggest that for Americans, social obligations are a matter of personal choice for the most part (Gardner et al., 2008; Rossi, 2001). One can therefore be excused not to continue obligations at home or at work if doing so begins to compromise the normative imperative of personal welfare and wellbeing. Indeed, Americans are quite high in relational mobility (Thomson et al., 2018). Thus, under such conditions, they may tend to opt out of the relationship and seek new relational opportunities outside. We should hasten to add, however, that all these could change if the obligations at issue were more serious and morally binding as when one had the care-taking role for family members who were ailing, aging, or both. Under such conditions, family obligations are known to carry health-compromising effects even among Americans (Kim et al., 2007).

Self-Rated Health

Curiously, when self-rated health was tested instead of biological health, conscientiousness was associated with better health in both Americans and Japanese. It is possible that this association is due to a semantic overlap between the self-report measure of conscientiousness (which is positive in valence) and the self-rated health measure (which is also positive in valence; Kitayama & Park, 2017). However, the self-rated health measure has been shown to be predictive of mortality (Ferraro & Wilkinson, 2015). Hence, it is likely to carry real health information. From this point of view, the American data pose no problem. Conscientious Americans did report that they are healthier supposedly because they are in fact objectively healthy.

Of importance, conscientious Japanese reported that they are relatively healthy despite the fact that they manifested compromised health at the objective level (as revealed in BHR). We speculate that one common strategy conscientious Japanese may use to focus on social obligation is to be negligent of their health. For example, they may ignore subtle signs of compromised health conditions or otherwise reinterpret them as more benign than they actually are. This cognitive style, a type of wishful thinking, may be required to carry out social obligations and duties even when one's own health conditions might not be ideal. Hence, we speculate that the high self-appraisal of health, evident among Japanese high in conscientiousness, might be self-deceptive, underscoring the potential power of this personality trait to bias health perception in goal-congruous manners, consistent with a growing body of evidence for motivated cognition (Dunning, 2015; Kunda, 1990).

Limitations and Conclusion

Some limitations of the current work are in order. First, our work is cross-sectional and, thus, no casual inferences are warranted. Second, we followed the current literature and assumed that both IL-6 and CRP are indicators of inflammation. Nevertheless, future work must use other neurobiological markers. For example, analyzing the transcriptional responses of genes linked to inflammation (Kitayama et al., 2016) may enable us to address the current hypothesis in greater detail. Third, the current analysis was motivated by the theoretical perspective that while conscientiousness motivates norm-congruent behaviors in all cultures, exactly what types of behaviors are normatively congruous depends on culture, particularly, whether culture emphasizes independence or interdependence. Future research should test this perspective further by extending the range of behaviors that are normatively congruous or not. Finally, conscientiousness is a global trait that could be decomposed into several distinct subcomponents (Chopik, 2016). Although centrally important, the dutifulness and diligence facets do not encompass the entire scope of this trait. Future research must examine whether other facets of conscientiousness, such as perfectionism, control, and cautiousness (MacCann et al., 2009), might work in any distinct fashion as they relate to biological health and molecular wellbeing.

Despite these limitations, our work is the first to show that the health-promoting potential of conscientiousness is culture-bound. This possibility is quite viable in the American cultural context we studied, but not at all so in Japan. Instead, in the latter, more collectivistic context, conscientiousness seems to come with overcommitments at both work and home that are potentially health-compromising.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material is available online with this article.

Notes

1. The biomarker sample included a small number of racial minorities (32 African Americans, six Native Americans, five Asian Americans, one multi-racial, 30 others, and four missing). The current analysis included all these participants. Prior cross-cultural work in the area (Kitayama et al., 2018; Park et al., 2019), however, excluded them and used data from 976 European Americans (532 females, M_{age} = 58.36, SD_{age} = 11.69). When this more restricted sample was tested, the results were no different.

2. Three additional sets of analyses were carried out. 1. The current measure of conscientiousness covered two facets of this personality trait (diligence and dutifulness). We analyzed each of these two facets separately and found similar patterns. Both diligence and dutifulness significantly interacted with culture to predict BHR; $b = .190$, 95% CI = [.019, .362], $t(1,380) = 2.18$, $p = .029$ and $b = .259$, 95% CI = [.105, .413], $t(1,380) = 3.30$, $p = .001$, respectively. As in the main analysis, for Americans, both facets were associated with reduced BHR, although the effect was somewhat weaker for diligence, $b = -.104$, 95% CI = [−.211, .003], $t(1,380) = -1.91$, $p = .056$, compared with dutifulness, $b = -.148$, 95% CI = [−.241, −.055], $t(1,380) = -3.13$, $p = .002$. In contrast, these relationships were statistically negligible for Japanese, $b = .086$, 95% CI = [−.049, .222], $t(1,380) = 1.25$, $p = .210$ and $b = .111$, 95% CI = [−.014, .236], $t(1,380) = 1.74$, $p = .082$, respectively. 2. In an auxiliary analysis, we controlled for the remaining four Big Five personality traits (i.e., neuroticism, extraversion, agreeableness, and openness to experience). This did not change the results. The Culture × Conscientiousness interaction effect remained significant, $b = .237$, 95% CI = [.048, .426], $t(1,372) = 2.46$, $p = .014$. As shown in the main analysis, conscientiousness was negatively associated with BHR among Americans, $b = -.180$, 95% CI = [−.296, −.063], $t(1,372) = -3.02$, $p = .003$, whereas there was no such association among Japanese, $b = .057$, 95% CI = [−.102, .216], $t(1,372) = .71$, $p = .480$. In another set of additional analyses, we also tested whether culture moderated any relationship between the remaining personality traits and BHR. The results of these analyses are summarized in Supplemental Table S1 and Figure S1.
3. Our main analysis was performed on the composite scores we created for key study variables, either by averaging multiple scale items (i.e., conscientiousness) or by extracting factor scores (i.e., BHR). In yet another auxiliary analysis, we tested our prediction using latent variables from structural equation modeling (SEM), which allows us to explicitly model error variances associated with each of the construct items, which makes the test more conservative (Ledgerwood & Shrout, 2011). We used SEM to estimate the critical interaction effect between culture and conscientiousness in predicting BHR with the same set of covariates included in the main analyses using AMOS software (version 26). When we compared a null model without the interaction effect with an alternative model where the interaction effect is estimated, the log-likelihood ratio test produced a significant result, $D(1) = 15.68$, $p < .001$, indicating that the inclusion of the interaction effect resulted in a significant improvement in model fit (Klein & Moosbrugger, 2000). This result suggests that the statistical conclusions for our main finding remain unchanged when latent variables are tested using SEM. In additional analyses, we categorized the five variables constituting the measure of healthy lifestyle into two groups—one based on health protective factors (healthy eating and physical activity) and one based on health risk factors (smoking status, alcohol consumption, and poor sleep quality)—and tested if these two facets might show different effects. The moderated mediation was significant regardless of which facet was tested as a mediator. The results from these additional analyses are reported in Figure S3 of Supplemental Materials.
4. See Supplemental Results for more details on these two moderated mediation analyses.

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