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The development of resilience in Japanese adults: A two-wave latent change model

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Abstract

This study examined the development of resilience in Japanese adults using a two-wave latent change model with 1284 Japanese adults (865 men, aged 20–69 years). The Bidimensional Resilience Scale was administered at both waves over a 2-year interval: January 2017 (Time 1) and January 2019 (Time 2). The results showed no significant mean-level change between Time 1 and Time 2, and relatively high stability. The latent change model indicated that changes in resilience varied significantly among individuals; however, sociodemographic variables were not significantly associated with variations in resilience. Resilience appears relatively stable in Japanese adults, despite individual variation.

Keywords

Japanese adults, latent change model, longitudinal study, personality development, resilience

In the recent years, the number of patients with mental disorders has increased internationally (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators, 2019; Wang et al., 2007), and interventions for psychopathological problems need to be developed and implemented. The concept of resilience has been discussed in the context of identifying ways to provide psychological support for individuals with mental illnesses. Resilience is defined as the mental ability to recover from difficulties (Masten, 2018), and consists of various factors. Hirano (2010) classified resilience into the following types of factors using the Temperament and Character Inventory (TCI) developed by Cloninger et al. (1993): innate factors that are strongly related to temperament and easily maintained, and acquired factors that are strongly related to character and rather easily acquired. The validity of this classification has been confirmed through both twin and longitudinal studies (Hirano, 2011, 2012). Resilience leads to maintaining and improving mental health and contributes to the prevention of mental diseases as well as recovery from maladaptation (Ueno et al., 2017). Various intervention programs have been developed based on cognitive behavioral therapy aiming to help individuals acquire and develop resilience (Robertson et al., 2015). However, the possibility that resilience is not fixed and might develop throughout one's life has not been quantitatively demonstrated.

The patterns of associations between resilience and age have been investigated by different researchers. Gooding et al. (2012) conducted a cross-sectional study in the United Kingdom and reported that the resilience of adults above 65 years was higher than that of young people between 18 and 25 years of age. Ueno et al. (2018) conducted a large cross-sectional study of Japanese adults ($N = 5143$, age range = 20–69 years) and found a linearly increasing trend for factors acquired with age and a curvilinear increasing trend for innate age-related factors. Other cross-sectional studies have suggested that resilience increases with age (e.g. Lundman et al., 2007; Nygren et al., 2005), which supports the mutuality principle suggested by Caspi et al. (2005). Conversely, Zeng and Shen (2010) conducted a cross-sectional study in the China and indicated that resilience declines after 65 years of age and becomes stable around the age of 85. Other studies have also indicated that

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resilience declines with aging (e.g. Beutel et al., 2009, 2010). Thus, results concerning the relationship between resilience and age are inconsistent among previous studies. These studies analyzed age-related changes in resilience based on cross-sectional surveys, and the trajectories of the development of resilience are considered pseudo. Moreover, these studies indicated that the development trajectories of resilience could differ depending on the person.

Investigations utilizing longitudinal surveys are thus required to analyze the diversity of resilience development based on individual characteristics. The development of resilience was examined in this study using the analysis method recommended in a previous study (McArdle and Nesselroade, 1994). The latent change model (LCM) is a model for longitudinally analyzing the development of different types of resilience (McArdle and Nesselroade, 1994). This model is also called the latent change score model (LCSM), because it shows the differences in scores between latent variables based on longitudinal data obtained in two waves. In the model, based on longitudinal factor analysis, intercepts (levels) and slopes (changes) are set in a high dimension and analyzed (McArdle and Nesselroade, 1994). Using this model, individual dispersion from the mean amount of change can be examined based on the variance of change, and factors affecting changes can be examined. For instance, Von Soest et al. (2017) conducted a study with Norwegian adults ($N = 5555$, age range = 45–84) that examined the LCM by considering the effects of sex and age, as well as the squared and cubed terms of age. The results indicated that the squared and cubed terms of age were negatively correlated with changes in self-esteem. Furthermore, Iimura and Taku (2018) examined various individual development types in a study using the LCM based on the significance of differences in changes. Based on the above, it is considered possible to perceive various forms of development of individual resilience through an analysis using the LCM, based on longitudinal data obtained in two waves. Understanding the development of resilience through longitudinal studies may provide fundamental insights for future solutions to psychopathological problems.

This study investigated changes in resilience scores using longitudinal data in two waves and examined the diversity in resilience development among Japanese adults. Specifically, (1) mean-level change, (2) relative stability, and (3) individual differences in changes were explored. Regarding individual differences in changes, the LCM, according to sex, age, and the squared term of age as variables, was developed and examined by referring to Von Soest et al. (2017) and Ueno et al. (2018). Previous research shows that the processes of development between innate and acquired factors could differ (Ueno et al., 2018). Therefore, using Hirano (2010, 2011, 2012) as a basis, in this study, changes were analyzed through the classifying of the resilience factors into two groups (Figure 1).

Methods

Participants and procedures

The participants in the study were Japanese adults who had participated in the Data-Sharing for Psychology in Japan (DSPJ) and Data-Sharing for Psychology in Japan 2nd Wave (DSPJ-2) projects. For the current project, participants were recruited from an Internet survey panel conducted by Cross Marketing, Inc., a major Japanese Internet survey company with approximately 3.8 million people in its pool of participants. The longitudinal survey was conducted using Qualtrics research software at two intervals: January 2017 (DSPJ = Time 1: T1) and January 2019 (DSPJ-2 = Time 2: T2). Of the 7993 participants in T1, responses with missing values were excluded. We requested 4650 participants who answered all the items in T1 to participate in the second survey (T2). Of the participants who completed both T1 and T2 surveys, data from 1284 participants (865 men; $M_{age} = 50.85$, $SD_{age} = 10.33$, age range = 20–69 years) were included in the analysis after excluding missing data. The participants were informed about the aims of the study and terms of confidentiality before the administration of the questionnaire. Participation was entirely voluntary, and participants' consent was obtained prior to the administration of the questionnaire. The survey was approved by the ethics committee of the institution with which the authors are affiliated (No. 2016-52, 2016-254, 18-286).

Measures

Resilience. Resilience was assessed using the Bidimensional Resilience Scale (BRS; Hirano, 2010). The BRS comprises 21 items in two dimensions: (1) innate factors such as optimism (e.g. "I think that things will work out on most occasions in any case"), control (e.g. "I can control my feelings even if there is a disagreement"), sociability (e.g. "I have been good at preserving friendships since I was a child"), and vitality (e.g. "I can carry out decisions until the end"); and (2) acquired factors such as problem-solving (e.g. "When I am faced with unpleasant situations, I try to gather information to solve the problem"), self-understanding (e.g. "I understand my personality well"), and understanding others (e.g. "I treat others with consideration"). The reliability and validity of the BRS have been confirmed previously (Hirano, 2010, 2011, 2012). Participants were required to answer using a 5-point Likert-type scale, ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The total score was obtained by summing the scores for each of the two dimensions, with higher scores indicating greater innate and acquired resilience factors. The Cronbach's alpha coefficient was found to be .86 for innate factors of T1, .86 for innate factors of T2, .80 for acquired factors of T1, and .80 for acquired factors of T2, thus confirming the internal consistency of the scale.

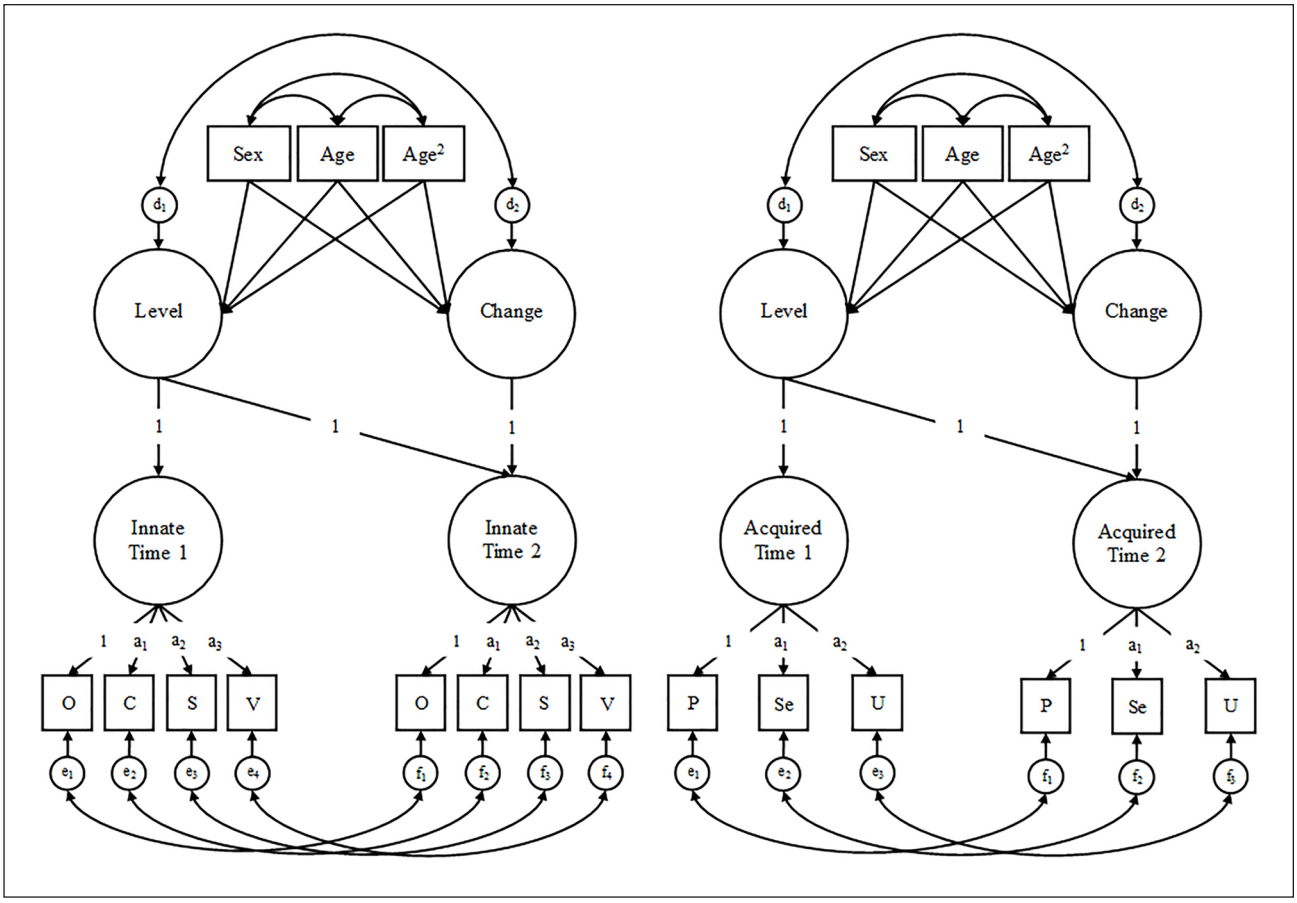

Figure 1. Latent change model for resilience as estimated in this study.
Innate: innate factors; Acquired: acquired factors; O: optimism; C: control; S: sociability; V: vitality; P: problem-solving; Se: self-understanding; U: understanding others; Age^2: squared term of age.

Confounding variables. To control for some confounding variables, this study collected data on participants' sex (0 = men, women = 1), age, and the squared term of age. Age was centered, and the squared term of age was obtained based on the centered age variable.

Statistical analyses

Descriptive statistics were calculated. The changes in the mean values of resilience scores at the 2-year intervals were examined using a paired *t* test. Cohen's *d* was used to determine the effect size in the paired *t* test, and based on Cohen (1988), the magnitudes of the effect sizes were small (equal to or more than .20 but less than .50), medium (equal to or more than .50 but less than .80), and large (.80 or above). Given the large sample size in this study, Pearson's correlation coefficient (*r*) was used to examine the relative stability. Individual differences in changes in resilience were examined using the LCM. Based on Von Soest et al. (2017) and Ueno et al. (2018), an LCM that included correlations with different attributes of the participants such as sex, age, and the squared term of age was developed. It was assumed that processes of development could differ between innate and acquired factors (Ueno et al., 2018). Therefore, based on Hirano (2010, 2011, 2012), changes were analyzed by classifying the resilience factors into two groups. We examined the significance of the mean difference and the variance of the levels and changes, as well as the correlations between the levels and changes (Iimura and Taku, 2018; Takahashi, 2015; Takahashi et al., 2013). Significant mean difference and variance of the change indicate that the resilience scores changed significantly between the two waves, and that the individual differences are large. Significant correlation coefficient between the levels and changes indicate a relationship between the resilience scores in T1 and development of resilience. Overall assessment of the model was conducted using the comparative fit index (CFI), standardized root mean residual (SRMR), and the root mean square error of approximation (RMSEA). The criteria for adopting the model included CFI = .90 or higher, SRMR = .08 or lower, and RMSEA = .10 or lower (Kline, 2005). Statistical analyses were conducted using the ggplot2 package (Wickham, 2016) of R version 3.5.2 (R Development Core Team, 2019) and HAD 16.056

Table 1. Descriptive statistics of resilience scores at Time 1 and Time 2 ($N = 1284$).

Variables	Time 1		Time 2		t	p	Cohen's d	r	p
	M	SD	M	SD					
Innate factors	3.06	0.56	3.03	0.58	3.22	.001	.06	.75	<.001
Acquired factors	3.28	0.52	3.27	0.53	1.11	.267	.02	.70	<.001

M: mean; SD: standard deviation.
Resilience is composed of two dimensions: innate factors and acquired factors. The t value is the result of a paired t test and the degree of freedom is 1283; r is the Pearson's correlation coefficients between Time 1 and Time 2 of the resilience scores.

Table 2. Latent change model results for level and change ($N = 1284$).

Variables	M	M SE	p	Var	Var SE	p
Innate factors						
Level	3.25	0.03	<.001	0.25	0.01	<.001
Change	−0.02	0.02	.177	0.11	0.01	<.001
Acquired factors						
Level	3.21	0.02	<.001	0.18	0.01	<.001
Change	0.01	0.02	.681	0.08	0.01	<.001

M: mean; Var: variance; SE: standard error.
Resilience is composed of two dimensions: innate factors and acquired factors. Correlation coefficients between the level and change were significant ($p < .001$): $r = –.28$ for innate factors, and $r = –.29$ for acquired factors.

(Shimizu, 2016), as well as IBM Amos version 23.0J for Windows (IBM SPSS Inc., Chicago, IL, USA). Since this study's sample size was large, the significance level was set at $p < .001$.

Results

Descriptive statistics

Descriptive statistics values of resilience scores used in this study were calculated (Table 1). There were no ceiling or floor effects in any variable according to the mean and standard deviations, and data were normally distributed. A paired t test was conducted to examine changes in the mean values of resilience, which indicated that the Cohen's d was rather small (.02–.06). Relative stability was examined by calculating Pearson's correlation coefficients for the resilience scores between T1 and T2, which indicated .75 for innate factors and .70 for acquired factors.

Latent change model

The goodness-of-fit indices used in this study were $\chi^2(49) = 583.290$, CFI = .904, SRMR = .052, RMSEA = .092 (90% confidence interval (CI) = .086–.099) for innate and $\chi^2(28) = 149.015$, CFI = .965, SRMR = .035, RMSEA = .058 (90% CI = .049–.067) for acquired factors. These results indicated goodness-of-fit indices in the acceptable range for both resilience factors.

Individual differences in changes of innate and acquired factors were examined by calculating the mean and variance of the changes and levels, which indicated that their means and variances were significant for both resilience factors (Table 2). The variance of changes was significant, whereas the mean was not. Moreover, the correlation coefficients of levels and changes indicated negative correlations for both resilience factors. The correlations between sociodemographic variables (sex, age, and the term of age squared), as well as the levels and changes, indicated positive correlations between age and both factors (Table 3). Conversely, there were no correlations between changes and any of the sociodemographic variables. The results of LCM indicate that age was significantly and positively associated with the mean of the levels, and variance of the changes was significant. Therefore, based on Carstensen et al. (2011), Figure 2 shows the relationship between age and resilience and the changes in resilience scores between the two waves according to age.

Discussion

Diversity in the development of resilience in Japanese adults was examined in this study using longitudinal data obtained at two intervals based on the following three perspectives: (1) changes in the mean values, (2) relative stability, and (3) individual differences in the changes. The analysis results of the longitudinal data collected in waves at 2-year intervals regarding changes in mean values indicated no significant differences in resilience scores. Moreover, the relative stability indicated that correlation coefficients of the variables between the two waves were relatively high for both resilience factors. The above results

Table 3. Latent change model results with predictor variables (*N* = 1284).

Variables	Predictor variables											
	Sex				Age				Age^2			
	B	*B SE*	β	*p*	*B*	*B SE*	β	*p*	*B*	*B SE*	β	*p*
Innate factors												
Level	.05	.04	.05	.145	.01	.00	.24	<.001	.00	.00	.04	.281
Change	−.01	.03	−.02	.594	.00	.00	.01	.737	.00	.00	−.03	.361
Acquired factors												
Level	.10	.03	.11	.001	.01	.00	.22	<.001	.00	.00	−.01	.784
Change	−.03	.02	−.05	.177	−.00	.00	−.02	.565	.00	.00	−.03	.387

B: unstandardized beta coefficient; *B SE*: standard error of unstandardized beta; β: standardized beta coefficient; Age^2: squared term of age. Resilience is composed of two dimensions: innate factors and acquired factors. The latent change model included correlations with different attributes of the participants such as sex, age, and the squared term of age.

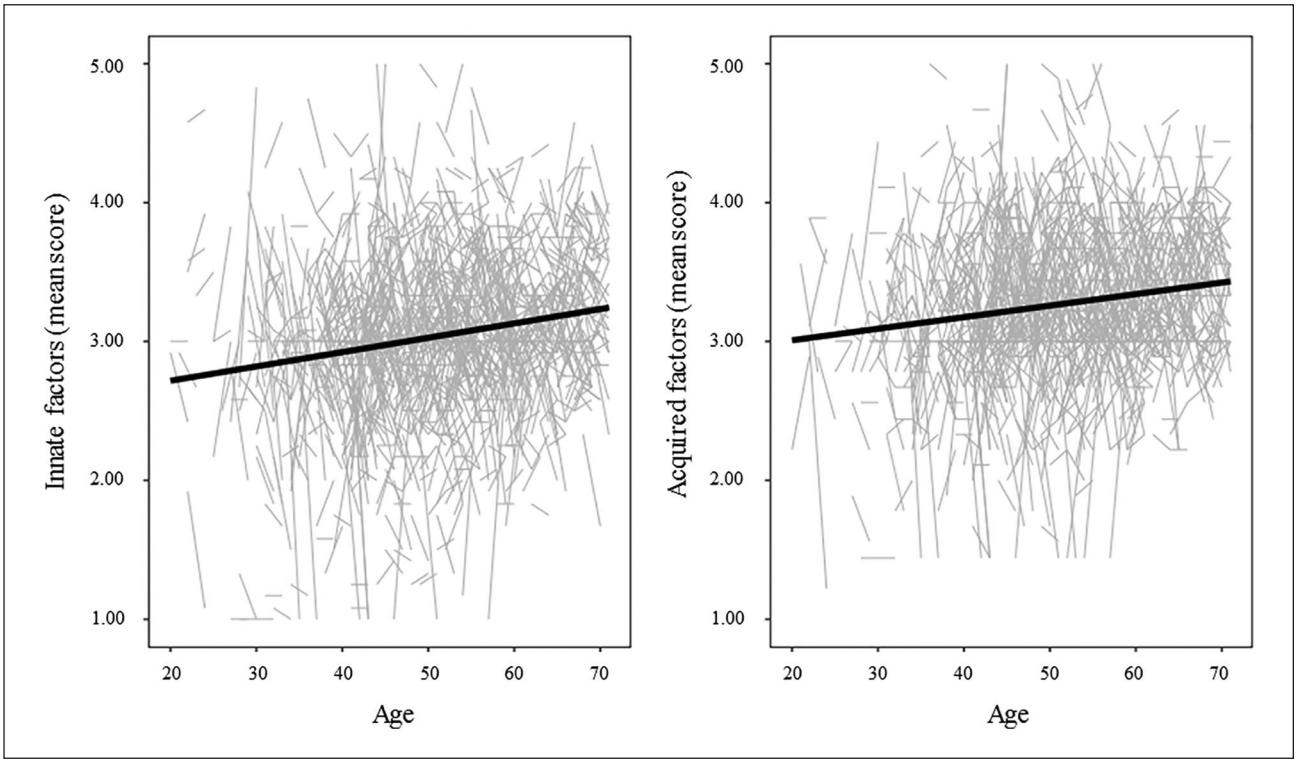

Figure 2. Two-wave changes in resilience scores by age (*N* = 1284).
Black line indicates the relationship between age and resilience. Gray lines indicate the changes in resilience scores between the two waves based on age.

were different from previous cross-sectional studies on the correlation between resilience and age (e.g. Gooding et al., 2012; Lundman et al., 2007; Nygren et al., 2005; Ueno et al., 2018). There is a possibility of personality traits changing over 2 years (Watson and Humrichouse, 2006); however, the resilience scores were somewhat stable when the mean values collected in the two waves were compared with the 2-year intervals, suggesting the possibility of no longitudinal changes.

Analyses were conducted using the LCM to examine individual differences in resilience changes, which indicated goodness-of-fit indices in the acceptable range for both resilience factors. The means of the changes were not significant for either factor, whereas the variance was significant. A significant difference was not indicated in the change of the mean values between the two waves, which is an identical result to the analysis of the LCM model, indicating relative stability between the two waves. Furthermore,

the variance in the level was significant from the starting point of observation, indicating differences in resilience scores based on the person. The variance of changes, suggesting individual differences in changes, was also significant, indicating diversity in resilience development depending on the person. The above results suggest that resilience scores of all Japanese adults do not always increase with age, but there are individuals showing no changes, or those showing a decline in resilience with aging. Previous studies on age-related changes in resilience have generally indicated that resilience increases with aging (e.g. Gooding et al., 2012; Lundman et al., 2007; Nygren et al., 2005; Ueno et al., 2018). However, there are studies indicating that resilience might moderately increase depending on different factors (Ueno et al., 2018), that resilience does not change in certain age groups (Zeng and Shen, 2010), or that resilience declines with age (Beutel et al., 2009, 2010). The results of this study supported these previous studies, suggesting a variety of age-related changes in resilience. Moreover, in both resilience factors, a negative correlation between the level and change was indicated, suggesting that participants with low initial resilience values might show a large change later. An intervention study aiming to increase resilience scores conducted by Hirano et al. (2018) indicated that those with lower initial values showed a larger change score later, which is consistent with the results of this study.

Age, as a factor correlated with levels and changes, showed a positive correlation with the levels of both resilience factors. This result supports previous findings of cross-sectional studies on the correlations between resilience and age (e.g. Gooding et al., 2012; Lundman et al., 2007; Nygren et al., 2005; Ueno et al., 2018). Sex had no correlation with the levels of either resilience factor; this finding is consistent with studies examining sex differences in resilience with participants of a wide age range (age range = 19–103), except for people in their 50s (Lundman et al., 2007). Furthermore, significant correlations were not indicated in each of the attribute variables related to changes for either type of resilience factors. Specifically, there was no effect of age on resilience, suggesting the amount of change in resilience might not differ according to age. The above results indicate that types of resilience development in Japanese adults are diverse, and moreover, sex or age might not influence the development of resilience. It is possible that resilience might change consistently among different age groups. Therefore, it is necessary to determine the everyday factors that promote the development of resilience, because such development that is related to the reduction of depressive symptoms is independent of age and sex. This may provide insights into preventing or addressing psychopathological problems. However, this study did not investigate teenagers or older adults above 70 years of age. Different results might thus be obtained when the age range of the study population is increased. Therefore, it is suggested that further investigations should be conducted to investigate these factors.

Finally, this study is not without its limitations. This study analyzed data obtained from a large-scale longitudinal study. However, it was longitudinal information collected at two points in time, which was not highly detailed. Therefore, the mean values and relative stability might change if the sample size is increased, or the survey period is extended. A longitudinal survey with samples in three waves should be conducted in the future, and development trajectories of individual resilience should be examined in detail. By using longitudinal data obtained at three or more intervals, the latent curve model (Duncan et al., 2013) could be used for analysis, which enables curve prediction. Moreover, examining correlations between changes in resilience, environment, and sociodemographic attributes might aid the investigation of factors facilitating individual development of resilience. Furthermore, when the variance of resilience change is high, group-based trajectory analysis (Nagin and Nagin, 2005) can be used. By clustering individual resilience development types and examining characteristics of each cluster, the diversity in development of individual resilience might be identified. In the future, more investigations should be conducted using these methods of analysis. In particular, although the factors that influence the development of resilience are not clear, it appears that developing an intervention that could enhance resilience could greatly contribute to improvement in health and longevity.

Availability of data

This study used data from the Data-Sharing for Psychology in Japan (DSPJ) and Data-Sharing for Psychology in Japan 2nd wave (DSPJ-2) project, conducted by Atsushi Oshio (Waseda University), Asako Miura (Osaka University), Tetsuya Kawamoto (The University of Tokyo), Yuki Ueno (The University of Tokyo), Yasuhiro Hashimoto (Teikyo University Junior College and Waseda University), Tadashiro Shimotsukasa (Waseda University), and Takahiro Mieda (Waseda University).

Declaration of conflicting interests

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