

Stress-related Growth and Perceived Health in Japanese People Living With HIV: Web-based Nationwide Participatory Research.

Taisuke Togari (✉ ttogari@ouj.ac.jp)

Open University of Japan

Yoji Inoue

Gaku Oshima

Sakurako Abe

Rikuya Hosokawa

Yosuke Takaku

Research

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Abstract

Background: For Japanese people living with HIV, this study aimed at the following: verifying the three-factor model of stress-related growth scales; confirming the impact of stress-related growth on mental health and physical symptoms; and determining differences in the effects of stress-related growth on health by time since HIV diagnosis.

Methods: A cross-sectional anonymous self-administered online survey which was prepared on the basis of the participatory research method was conducted from July 2013 to February 2014 and from December 2016 to July 2017 for all Japanese web users living with HIV. We analyzed the data of 1,422 participants who responded regarding the number of years since diagnosis and where transmission was sexual. The mean age (standard deviation) was 38.6 (8.3) years.

Results: Stress-related growth comprises three factors: self-perception, interpersonal relationships, and philosophy of life. In the group over 4 years since diagnosis, logistic and Poisson regression analysis simultaneously including all the scales showed a positive effect; in the group with less than 4 years since diagnosis, such an association was found only for self-perception. In the group with over 4 years since diagnosis, positive growth in interpersonal relationships and self-perception led to reduced somatic symptoms; however, philosophy of life was linked to increased physical symptoms. When the group with less than 4 years since diagnosis was included, no correlation was evident with philosophy of life; positive growth in self-perception led to reduced physical symptoms; positive changes in interpersonal relationships produced increased physical symptoms.

Conclusions: Toward assisting people living with HIV/AIDS, we found that personal and group relationships played an important role in creating positive changes regarding respondents' perceptions of life and other people.

Introduction

In Japan, the number of new HIV/AIDS cases was 1,317 in 2018 (1,389 in 2017) [1]. The total number of reports for 1985–2018 was 30,149 (including those who subsequently died)[1]. Evidently, the number of HIV/AIDS patients is increasing annually in Japan.

The issue of the stigma surrounding HIV has been reported in numerous countries; it is apparent that HIV infection imposes a mental and physical burden[2–9]. In the most recent Japanese survey, 85.2% of participants stated that it was unsafe to reveal to others that they were HIV positive[10]; 65.9% declared that they were striving to ensure that no one around them realized their condition. These findings demonstrate that a significant stigma related to HIV[10] persists, which imposes a heavy burden.

Consequently, stress is high among people living with HIV (PLWH) in Japan. Specifically, in terms of mental health, PLWH are at higher risk of depression and anxiety disorder than the general population[10–12]. Thus, there is an urgent need to develop appropriate solutions.

These stressful conditions can damage the mental health of many individuals; however, some PLWH manage to stay healthy and even flourish[10]. Such concepts as stress-related growth (SRG), post-traumatic growth (PTG), and benefit finding (BF) have recently received attention as explanations for this phenomenon[13–15]. SRG is defined as “actual or veridical changes that people have made in relation to their experience with an identified stressful or traumatic event”[13]. SRG and PTG are similar in that both concepts reflect true developmental change that occurs owing to stress[16,17]. According to Tedeschi and Calhoun, change occurs in the following three categories: self-perception; interpersonal relationships; and philosophy of life[18]. PTG is a form of growth that may occur as a result of high levels of stress and “seismic” events (e.g., natural disasters and war). By contrast, SRG arises from traumatic events as well as from chronic stressors (e.g., everyday stressors and care-giving responsibilities)[19–21]; thus, the concept of SRG covers a broader range of phenomena.

In general, the SRG scale (SRGS; 50 items)[13], PTG inventory (PTGI; 21 items)[18], perceived benefit scales (38 items)[22], and BF scale (BFS; 14–30 items)[23] are used to measure SRG. With all those scales, respondents evaluate the degree of change they have undergone as a result of their most stressful experiences with regard to each item. However, the scales do not agree regarding constructs. SRGS is a one-dimensional construct. PTGI is a five-dimensional construct that comprises the following: relating to others; new possibilities; personal strength; spiritual change; and appreciation[18]. The BFS consists of two dimensions: personal growth and acceptance. Thus, the number of dimensions involved in measuring SRG differs according to the scale employed; there is no single accepted approach.

One meta-analysis and a systematic review clarified that SRG was very strongly correlated to mental health[17,24]. SRG affects both mental and physical health. However, compared with the number of studies on SRG and mental health, little research has investigated the correlation between SRG and physical health. Most studies found that SRG is related to improved physical health[25]. For example, Affleck et al. determined that among participants who reported SRG, the likelihood of subsequently suffering a heart attack was significantly lower[26]. The mechanism of the association between SRG and physical health may involve mental and biological factors, such as stress-coping strategies and responses to biological stress[19].

Some studies have investigated SRG in PLWH. For example, Milam found that in PLWH with high SRG, objective biological indicators, such as CD4 cell levels and disease progression, may proceed more slowly[27]. Carrico et al. determined that BF had a direct effect on depression in male and female PLWH[28]. Updegraff et al. observed that a positive change with SRG was negatively associated with depressive symptoms; they reported it was not associated with anxiety and general health among American female PLWH. The authors found that a negative change with SRG was positively associated with depressive symptoms and anxiety, and it was negatively associated with general health[29].

Using an original SRGS with American female PLWH, Siegel et al. determined that SRG was correlated with a lack of depressed moods[30]. Further, an investigation of the same group of participants verified that SRG had a direct effect on depression and exerted a stress-buffering effect; SRG was found not to

have an association with physical health[31]. Littlewood et al. found that BF had a negative correlation with physical symptoms, a significant negative correlation with depression, and that BF had an indirect effect on depression through social support[15]. Sawyer et al. performed a meta-analysis of 38 studies on SRG in subjects with cancer and HIV (eight studies on HIV). They reported that SRG had a positive effect on positive mental health and physical health; it had a negative effect on negative mental health[32].

From the above studies, SRG is evidently a key concept in health promotion (including mental health) among PLWH. It appears that it will become increasingly important for support for PLWH to focus on SRG. Thus, it is apparent that several topics demand investigation. First, the relationship between SRG and physical or somatic symptoms among PLWH has not been sufficiently researched[33]. According to one systematic review, there is no a consensus on the relationship between SRG and mental health[33].

Second, with regard to measuring SRG, as described above, most investigations have used SRG measurement tools that are limited to positive changes, such as growth and benefit. However, some studies have reported that negative cognitive changes and experiences of loss apparently occur in response to illness[34]. Additionally, it has been asserted that negative survey items should be used as filler items in studies on growth and benefit owing to the high degree of social desirability bias.[35] Several studies on SRG have therefore simultaneously investigated positive and negative changes. For example, one study of HIV-positive participants developed a 10-item scale called the Impact on Self-Concept Scale; it comprised two subscales, one with seven items on self-loss and the other with three items on self-growth[36]. Another study of child patients with serious illnesses, rather than HIV-positive participants, developed and implemented an SRGS with two subscales of perceived benefit and perceived burden[35].

When psychological strength, partner bonding, and other such concepts are investigated, they have been found to grow stronger, become weaker, or remain the same after a traumatic event. Such cognitive changes could therefore be measured on a single axis with “no change” as the starting point. In fact, in the study on Japanese PLWH where HIV was caused by contaminated blood products, mentioned above, SRG was measured on a single axis.[37] We employed the same scale in the present study; rather than just assessing growth and benefit, we applied the concept of “perceived positive-negative change,” allowing measurement of negative changes on one axis.

Third, many studies have treated SRG as a single factor; thus, the relationship among its component elements have hitherto not been sufficiently elucidated. For example, the three elements suggested by Tedeschi and Calhoun (self-perception, interpersonal relationships, and philosophy of life) are strongly correlated as sub-concepts in the construct of SRG[18]. However, it is possible that those elements may function independently, i.e., some people may exhibit improvements in terms of self-perception but deterioration with interpersonal relationships. Further, an examination of the subscales should clarify correlations among them; it should also allow additional practical applications by providing more specific and concrete conceptual details.

Fourth, the effect of the time since HIV diagnosis on the extent of SRG has not been adequately investigated. Calhoun et al. theoretically demonstrated that the extent of generated SRG differs both quantitatively and qualitatively according to the length of time that passed since a traumatic event[38]. However, those studies were not limited to HIV-positive participants; they did not clarify how the time since the event was confirmed. To investigate the measurement and functions of SRG and apply study results to on-site practice, it is necessary to address the duration since the event.

Fifth, there is a lack of Japanese studies in this area. Notably, no investigations on SRG in PLWH have been undertaken; the exception is one report in which an association was found between SRG and depression in PLWH where HIV was caused by contaminated blood products[37].

On the basis of the above discussion, this study aimed to clarify the following three points among PLWH. First, we aimed to verify the three-factor model of stress-related growth scales. Second, we attempted to confirm the relationship impact between subscales of stress-related growth and mental health. Third, we aimed to confirm the relationships between subscales of stress-related growth and somatic symptoms. We also examined differences in the effects of stress-related growth on health by time since HIV diagnosis.

Methods

Participants and methods

This cross-sectional study employed data from the first and second HIV Futures Japan (HFJ) nationwide surveys (HFJ-wave1 and HFJ-wave2) of Japanese PLWH. HFJ-wave1 was an anonymous self-administered Web survey conducted from July 2013 to February 2014. A participatory research method was used to implement the survey; advertising and recruiting were achieved through support groups for PLWH, a public Twitter account, a public Facebook account, and 400 HIV treatment institutions across Japan. Responses were obtained from 1,095 people; after data cleaning, 913 valid responses remained. HFJ-wave2 was implemented from December 2016 to July 2017 using the same survey format as that for HFJ-wave1; 1,110 individuals responded, resulting in 1,038 valid responses.

The results from 579 individuals who responded to HFJ-wave2 but did not respond to HFJ-wave1 were combined with the 913 valid responses from HFJ-wave1. We then analyzed the data from 1,422 individuals who responded regarding the number of years since HIV diagnosis and where transmission was sexual. A flowchart of the sample appears in Figure 1. The mean age (SD) was 38.6 (8.3) years.

Variables

Stress-related growth

We used the perceived positive and negative change scale based on SRG and PTG theory to assess both positive and negative changes in Japanese hemophilic patients infected with HIV by contaminated blood products.[37] We applied the scale to measure SRG for PLWH with sexual transmission. The

scale was based on the theory of Tedeschi and Calhoun regarding the three elements of self-perception (SP), interpersonal relationships (IR), and philosophy of life (PL)[18]. The scale measures the following 10 attributes with respect to the time the respondent was infected with HIV to the time of the survey: confidence to get through life (SP1); mental strength (SP2); purpose in life/life enjoyment (SP3); way of thinking about things (SP4); way of thinking about daily life (PL1); concern for health (PL2); desire to be useful to society and others (PL3); ties with friends (IR1); trustworthy friends and acquaintances (IR2); and partner or family ties (IR3). We measured each attribute using a Likert scale with a single axis and two negative and positive poles. For example, the scale featured the following five-level item: "Since I was diagnosed with HIV, I have grown psychologically weaker (-2), slightly weaker (-1), neither weaker nor stronger (0), slightly stronger (+1), or stronger (+2)." We calculated the mean score of each subscale.

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) was developed to screen for depression and anxiety in patients with physical diseases. It comprises seven items, with three levels for both depression (HADS-D) and anxiety (HADS-A)[39]. We used the Japanese version in the present study; as in previous investigations, we set the cutoff at 11 points[40]. The prevalence of those conditions in Japan is 4.8% for anxiety disorder and 2.9% for depression[40].

Number of physical symptoms

The respondents were asked about 41 items concerning physical symptoms (such as fatigue, headache, vertigo, stiff shoulder, limb numbness, audiovisual symptoms, gastrointestinal symptoms, motor apparatus symptoms, and urological symptoms). In our analysis, we used count values for those responses.

Control variables

Sexuality. We generated three categories: female, male heterosexual, and other.

Age. At the time of the survey, respondents were asked their age. We treated this as a continuous variable.

Years since HIV diagnosis. Respondents were asked, "When did you learn you were HIV positive?" We calculated the number of years from HIV diagnosis to the time of the survey.

Educational level. We established three categories: middle or high school; vocational school, junior college, or technical college; and university or graduate school.

Annual income. We categorized personal annual income as follows: <1 million yen (about US\$9,090); 1 million to <3 million yen (about \$27,200); 3 million to <5 million yen (about \$45,450); 5 million to <8 million yen (about \$72,700); and 8 million yen or more.

Analysis methods

In our analysis, we divided respondents into two groups based on duration since HIV diagnosis: under 4 years and over 4 years. It was necessary to determine the number of years that passed since diagnosis because a certain time is necessary for cognitive change to take place. We based our approach on the experience of people who support PLWH in Japan: they generally offer assistance under the assumption that it takes at least 3–4 years to produce a change in patients' self-management.

First, regarding the perceived positive and negative growth scale, we conducted a confirmatory factor analysis on the three hypothetical categories of factors that were created. In the confirmatory factor analysis, we performed a multi-group analysis on groups with less than and more than 4 years since HIV diagnosis. To determine goodness of fit, we compared the following: a model with open parameters for both groups; a model with equality constraints on the covariance and path coefficient values for both groups; and a model with equality constraints on the error variance in addition to the covariance and path coefficient. We used the Tucker-Lewis coefficient (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) values as indicators of fit.

Second, we determined the psychological scale characteristics of the three perceived positive and negative growth subscales. We employed Cronbach's α coefficient for internal consistency. We undertook the Student t test to compare the distributions of each group.

Third, we employed the following in a multivariate analysis: HADS-D, HADS-A, and physical symptoms as dependent variables; the three perceived positive and negative growth subscales as independent variables; and sexuality, age, years since HIV diagnosis, educational level, and annual income as control variables. We conducted a binary logistic regression analysis on the HADS-D and HADS-A scores. We undertook a Poisson regression analysis on the number of physical symptoms. We calculated an estimated index parameter value (indicated as the odds ratio in the logistic regression analysis and as the risk ratio in the Poisson regression analysis) and the 95% confidence interval. From the theoretical relationships among the scales, we conducted a hierarchical regression analysis by inserting philosophy of life in model 1, interpersonal relationships in model 2, and self-perception in model 3 sequentially.

We conducted statistical analyses packages using IBM SPSS Statistics 24 and IBM SPSS Amos 24 (Armonk, NY).

Table1. Distributions about demographic characteristics by years since HIV diagnosis				
	Years since HIV diagnosis			
	Less than 4-year (n=638)		4-year or more (n=784)	
	n	(%)	n	(%)
Sexuality				
Female	14	(2.2)	27	(3.4)
Male				
Heterosexual	18	(2.8)	18	(2.3)
Other	606	(95.0)	739	(94.3)
Education level				
Middle school/high school	222	(34.8)	272	(34.7)
Vocational school/junior college/technical college	105	(16.5)	157	(20.0)
University/graduate school	311	(48.7)	355	(45.3)
Annual income				
<1,000,000 yen	87	(13.6)	122	(15.6)
1,000,000 - 3,000,000 yen	207	(32.4)	230	(29.3)
3,000,000 - 5,000,000 yen	201	(31.5)	236	(30.1)
5,000,000 - 8,000,000 yen	106	(16.6)	118	(15.1)
8,000,000 yen or more	26	(4.1)	60	(7.7)
Missing	11	(1.7)	18	(2.3)
HADS-D				
depression	177	(27.8)	210	(26.9)
HADS-A				
anxiety	232	(36.4)	241	(30.8) †
Age				
mean(SD)	35.8	(8.1)	40.5	(7.8)
Number of Symptoms				
median(Q ₁ ,Q ₃)	3	(1, 6)	2	(0, 5)
†p=.026 in χ^2 test				

Results

The characteristics of the groups based on time since HIV diagnosis appear in Table 1. Only age was found to differ between the two groups ($P < .001$).

Table 2. Multiple group confirmatory factor analysis with less than and more than 4 years since HIV diagnosis for three-factor stress related growth scale					
model	χ^2	df	TLI	CFI	RMSEA
model1	362.60	64	0.89	0.94	0.057
model2	384.61	77	0.91	0.94	0.053
model3	430.08	87	0.91	0.93	0.053
model1 unfixed model					
model2 equality constraints on the covariance and path coefficient values of both groups					
model3 model2 equality constraints on the error variance					

The CFA results are presented in Table 2. For all the models, the fit indexes were 0.89–0.91 for TLI, 0.92–0.94 for CFI, and 0.05–0.06 for RMSEA. Among these, even in the model with the greatest number of constraints (i.e., with equality constraints on the covariance, path coefficient, and error variance between the two

groups), the goodness of fit was similar to that with other models. Thus, we selected that model with the greatest number of constraints; the standardized path coefficient and correlation coefficients appear in Figure 2. The psychological scale characteristics of the three perceived positive and negative growth subscales are displayed in Table 3. The mean values for self-perception and interpersonal relationships were negative; it was evident that a considerable number of

	Item N	Range	α	Years since HIV diagnosis				
				Less than 4-year		4-year or more		p
				mean	(SD)	mean	(SD)	
Growth in self-perception	4	-2 to 2	.831	-0.35	(0.86)	-0.07	(0.93)	<.001
Growth in interpersonal relationships	3	-2 to 2	.690	-0.05	(0.75)	-0.02	(0.79)	.594
Growth in philosophy of life	3	-2 to 2	.620	0.36	(0.80)	0.41	(0.82)	.291

respondents experienced negative growth. The two groups exhibited a significant difference ($P < .001$) in

the mean scores for self-perception; however, we did not observe such a difference for philosophy of life and interpersonal relationships.

The results of the logistic regression analysis about the impact of perceived positive and negative growth scale on HADS-D appear in Table 4. In the group with less than 4 years since HIV diagnosis, philosophy of life and interpersonal relationships had no direct effect on depression; only self-perception had a direct effect. In the final model, the positive growth in self-perception had an inhibitory association with the risk of depression. Further, in both groups, the odds ratios for philosophy of life and interpersonal relationships decreased between models 1 and 3.

The results of the logistic regression analysis about the impact of perceived positive and negative growth scale on HADS-A scores are presented in Table 5. In the group with less than 3 years since HIV diagnosis, philosophy of life and interpersonal relationships did not have a direct effect on anxiety scores; only self-perception had an effect. In the final model, the odds ratio (with 95% confidence intervals [CI]) for self-perception was .44 (.40–.57); positive growth in self-perception had an inhibitory association with the risk of anxiety disorder. In both groups from models 1 to 3, we observed a decrease in the effect size of philosophy of life.

The results of the Poisson regression analysis regarding the impact of perceived positive and negative growth scale on the number of physical symptoms appear in Table 6. Philosophy of life had no direct effect in the group with less than 3 years since HIV diagnosis; both self-perception and interpersonal relationships had significant effects. In model 3, regarding risk ratio (95% CI), with self-perception at .73 (.69–.77), positive changes led to a reduction in the number of symptoms; however, with interpersonal relationships at 1.12 (1.05–1.19), positive changes produced an increase in the number of symptoms. Further, in the group with more than 3 years since HIV diagnosis, the three subscales had a significant effect in model 3. Specifically, in model 3, regarding risk ratio (95% CI) with philosophy of life at 1.16 (1.10–1.23), positive changes led to an increase in the number symptoms; however, with self-perception at .75 (.72–.79) and interpersonal relationships at .82 (.78–.87), positive growth led to a decrease in the number of symptoms. From models 1 to 3, the effect size of philosophy of life decreased and reversed.

Table4. Logistic regression analysis of the associations between growth sub-scales and depression												
	Bivariate			Model1			Model2			Model3		
	OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI	
		[lower,	upper]		[lower,	upper]		[lower,	upper]		[lower,	upper]
Years since HIV diagnosis												
Less than 4-year												
'philosophy of life'	.44	[.34,	.56]	.44	[.34,	.56]	.54	[.41,	.71]	.77	[.58,	1.04]
'interpersonal relationships'	.42	[.33,	.55]				.59	[.44,	.79]	.75	[.55,	1.01]
'self-perception'	.33	[.26,	.42]							.40	[.30,	.53]
-2log likelihood				666.59			653.68			613.51		
Nagelkerke R ²				.14			.17			.25		
4-year or more												
'philosophy of life'	.40	[.32,	.49]	.39	[.31,	.49]	.50	[.39,	.64]	.73	[.55,	.96]
'interpersonal relationships'	.41	[.32,	.51]				.55	[.42,	.71]	.71	[.54,	.94]
'self-perception'	.30	[.24,	.38]							.40	[.31,	.53]
-2log likelihood				810.83			788.57			737.76		
Nagelkerke R ²				.16			.19			.27		
OR: odds ratio												
Model1-3 were adjusted for sexuality, age, education and annual income.												

Table5. Logistic regression analysis of the associations between growth sub-scales and anxiety												
	Bivariate			Model1			Model2			Model3		
	OR	95%CI		OR	95%CI		OR	95%CI		OR	95%CI	
		[lower,	upper]		[lower,	upper]		[lower,	upper]		[lower,	upper]
Years since HIV diagnosis												
Less than 4-year												
'philosophy of life'	.67	[.54,	.82]	.70	[.57,	.86]	.84	[.66,	1.07]	1.17	[.90,	1.53]
'interpersonal relationships'	.59	[.47,	.75]				.66	[.51,	.86]	.82	[.62,	1.08]
'self-perception'	.45	[.37,	.56]							.44	[.40,	.57]
-2log likelihood				787.12			777.22			735.96		
Nagelkerke R ²				.06			.08			.16		
4-year or more												
'philosophy of life'	.57	[.47,	.69]	.59	[.48,	.71]	.76	[.61,	.94]	.98	[.76,	1.26]
'interpersonal relationships'	.50	[.40,	.61]				.54	[.43,	.69]	.64	[.50,	.82]
'self-perception'	.49	[.41,	.59]							.58	[.46,	.74]
-2log likelihood				905.48			878.72			856.88		
Nagelkerke R ²				.09			.13			.17		
OR: odds ratio												
Model1-3 were adjusted for sexuality, age, education and annual income.												

Table6. Poisson regression analysis of the associations between growth sub-scales and number of symptoms												
	Bivariate			Model1			Model2			Model3		
	RR	95%CI		RR	95%CI		RR	95%CI		RR	95%CI	
		[lower,	upper]		[lower,	upper]		[lower,	upper]		[lower,	upper]
Years since HIV diagnosis												
Less than 4-year												
'philosophy of life'	.88	[.84,	.93]	.91	[.86,	.95]	.90	[.85,	.95]	1.02	[.96,	1.09]
'interpersonal relationships'	.93	[.88,	.98]				1.02	[.96,	1.08]	1.12	[1.05,	1.19]
'self-perception'	.76	[.73,	.80]							.73	[.69,	.77]
AIC												
				3862.29			3826.86			3708.93		
4-year or more												
'philosophy of life'	.87	[.83,	.91]	.88	[.85,	.92]	1.01	[.96,	1.07]	1.16	[1.10,	1.23]
'interpersonal relationships'	.74	[.71,	.78]				.75	[.71,	.79]	.82	[.78,	.87]
'self-perception'	.74	[.71,	.77]							.75	[.72,	.79]
AIC												
				5210.57			5067.96			3709.17		
RR: risk ratio												
Model1-3 were adjusted for sexuality, age, education and annual income.												

Discussion

Distribution of study participants

In a 2013 survey conducted through medical institutions on Japanese HIV-positive participants (n = 1,100), the average age was 44.6 years; with 24.3% of participants, the time since HIV diagnosis was less than 3 years[41]. The participants in the present study (average age, 36.6 years; with 32.6% of participants the time since HIV diagnosis was less than 3 years) were somewhat younger and had learned about their diagnoses more recently. In the earlier survey, the participants were regular outpatients at nine Japanese central medical institutions; however, our sample included some participants who belonged to a different group (e.g., ones who had been found to be infected and were undergoing treatment) from those in the previous study. We consider our participants representative of the target population: our participants were all living in the same Japanese prefecture; they were seeing a doctor at a non-central medical institution; and they included individuals who had not yet been treated.

Factor structure and subscales of SRG

In the present study, we verified that the perceived positive and negative growth scale comprised three factors[18]. Further, we confirmed that the factor structure was a metric invariance model that was not based on the number of years since HIV diagnosis.

With regard to the mean score of the subscales, those of self-perception and interpersonal relationships were negative. Similar scales assessing PTG, the SRGS, and the BFS in previous studies showed only positive changes. The index used in the present investigation also showed negative changes; thus, it can be said that it depicts changes in cognitive beliefs more accurately than those used in previous reports. Additionally, the present results suggest that the event of receiving the HIV diagnosis and subsequent stressful experiences (such as self-management of the illness and stigmatization) caused negative cognitive changes; those changes may have occurred in approximately half of our participants.

Mechanism of association between mental health and SRG

With regard to the association between the two variables, as indicated in previous studies and review papers[31,33], we clearly observed a negative association between the subscales of the perceived positive and negative growth scale and mental health. Further, with respect to the association with mental

health based on correlation between the subscales, the mechanism was different between the group with less than 4 years since HIV diagnosis and that with over 4 years.

First, in the group with less than 4 years since HIV diagnosis, self-perception had a direct effect on both depression and anxiety disorder, philosophy of life and interpersonal relationships exerted only an indirect effect, which was mediated by self-perception. This result indicates the extremely important role of positive changes in self-perception in maintaining and improving mental health in the 4 years following HIV diagnosis. This phenomenon may be caused by the bidirectional nature of self-perception and mental health concepts.

Second, in the group with over 4 years since HIV diagnosis, self-perception and interpersonal relationships were both associated with maintaining and improving mental health. It was also evident that in addition to self-perception and interpersonal relationships, philosophy of life was correlated with depression.

Mechanism of association between number of physical symptoms and SRG

The association between the number of physical symptoms and the perceived positive and negative growth scale was not sufficiently clarified in previous studies[29,31]; however, the present investigation suggests the possibility of a strong association. It is clear that as in the case of mental health, this association has mechanisms and effects that differ significantly depending on the number of years since HIV diagnosis. For example, in the group with less than 4 years since diagnosis, positive growth in self-perception was associated with reduced symptoms; however, it was also apparent that positive changes in interpersonal relationships were associated with increased symptoms. In the initial period after HIV diagnosis, it is possible that individuals with more symptoms seek help and establish personal connections. The 41 symptoms investigated in the present study included a wide range of audiovisual, respiratory, circulatory, digestive, dental, dermatological, musculoskeletal, urinary tract, and other symptoms. In future, it will be necessary to categorize these symptoms with greater precision and investigate their association with SRG.

For the group with less than 4 years since HIV diagnosis (unlike the other group), it was apparent that for both interpersonal relationships and self-perception, positive changes were correlated with reduced symptoms. It could be that personal connections, which took 4 or more years to develop, helped suppress symptom development. This finding also suggests that when both self-perception and interpersonal relationships are considered, positive growth in philosophy of life led to an increase in the number of symptoms. Thus, having more symptoms in 4 or more years since HIV diagnosis could lead to strong positive changes with philosophy of life owing to various difficult experiences.

Very few studies have examined the association between physical health and SRG: some investigations have even reported a positive relationship with good physical health. In the present study, it was apparent that there was a close relationship between the two. However, our results suggest that this relationship was not necessarily positive; it could also be negative. Therefore, in future, it will be necessary to examine physical symptoms from multiple perspectives.

Theoretical and practical suggestions

This study has produced the following two theoretical suggestions. First, regarding changes in respondents' perceptions of themselves and their world, owing to chronic and acute stresses (such as negative events and illnesses), it would be more precise to measure both positive (such as growth and discovery of benefits) and negative aspects.

Second, this study found that though it is possible to measure SRG after a traumatic event regardless of the length of elapsed time, functions related to health differ greatly depending on the duration. Further, mental and physical health as well as the functions that act on them differ greatly depending on the SRG subscale. Not all elements of SRG have a positive influence on health. In future, it will be necessary to further investigate the functions of these subscales.

The present study also led to the following two practical suggestions. First, toward assisting PLWH, we found that personal and group relationships played an important role in creating positive changes regarding our respondents' perceptions of life and of people around them. Moreover, particularly among PLWH with over 4 years since diagnosis, diverse educational programs and opportunities to take courses would be useful in facilitating adaptation to self-management and to produce changes in perceptions of themselves and others.

Second, it is possible that the perceived positive and negative growth scale could be applied as a self-management tool for PLWH. In this regard, it will be necessary also to consider developing intervention policies to promote positive cognitive change.

Limitations and future studies

This study clarified the structure of the SRG factors in Japanese HIV-positive males as well as the mechanism behind the associations among factors that affect mental health and physical symptoms. However, this study has a number of limitations.

First, with regard to sampling, this study was an open online survey, and it is possible that our sample was restricted to skilled users of computers and mobile terminals. Specifically, with our sample, the age range was lower than that of participants surveyed through medical institutions and a shorter time had passed since HIV diagnosis. The overall picture of Japanese PLWH has yet to emerge: it may not be that there was participant bias in our study or that the participant sample in the previous survey (contacted through medical institutions) was representative. However, in future, it will be necessary to confirm the reproducibility of our results among older participants who may have difficulty in accessing an Internet-based survey.

Second, the reliability of the perceived positive and negative growth scale used in this study has yet to be fully determined. Its internal consistency is somewhat low. While investigating the reproducibility in other samples, it will be necessary to investigate test-retest correlations.

Finally, with regard to the cross-sectional design, this study applied several hypotheses and models, which we sought to verify, based on the notion that SRG has an impact on mental health. Additionally, our results suggest that SRG has a bidirectional causal relationship with mental health. Owing to the limitations of investigating causal relationships with a cross-sectional study design, it will in future be necessary to conduct a detailed investigation of the reproducibility and causal relationships using a longitudinal design.

Conclusion

This nationwide survey of Japanese PLWH using a cross-sectional design clarified the following three points regarding SRG resulting from HIV diagnosis.

1. SRG comprises three factors: self-perception, interpersonal relationships, and philosophy of life. The factor structure and measurement of these subscales remained constant irrespective of the number of years since HIV diagnosis.
2. The mechanism of the association between the scales and mental health changed depending on whether more or less than 4 years had passed since HIV diagnosis. In the group with over 4 years since diagnosis, multivariate analysis simultaneously including all the scales showed an independent positive effect. With the multivariate analysis that also included the group with less than 4 years since diagnosis, such an association was found only for self-perception.
3. The physical symptoms of each scale and the association mechanisms differed according to the time since HIV diagnosis. Multivariate analysis showed that in the group with over 4 years since diagnosis, positive growth in interpersonal relationships and self-perception led to a reduction in physical symptoms; however, philosophy of life was linked to increased physical symptoms. When the group with less than 4 years since diagnosis was included, no association with philosophy of life was found; however, positive growth in self-perception led to reduced physical symptoms, and positive growth in interpersonal relationships led to better physical health.

Abbreviations

AIDS: acquired immune deficiency syndrome

BF: benefit finding

CD4: cluster of differentiation 4

CFI: comparative fit index

HADS: hospital anxiety and depression scale

HIV: human immune virus

OR: odds ratio

PLWH: people living with HIV

PTG: posttraumatic growth

RMSEA: root mean square error of approximation

RR: risk ratio

SRG: stress-related growth

TLI: Tucker-Lewis coefficient

Declarations

Ethics approval and consent to participate

Informed consent was obtained from all individual participants included in the study.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (Open University of Japan, 2016-23) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no conflict of interest.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, TT, upon reasonable request. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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Authors' contributions

TT and YI involved in the conception, designing methods, analysis, interpretation and drafting of the manuscript. OG, SA, RH and YT participated in designing, data analysis, interpretation of the findings and write up of the findings. All authors read and approved the final manuscript.

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Figures

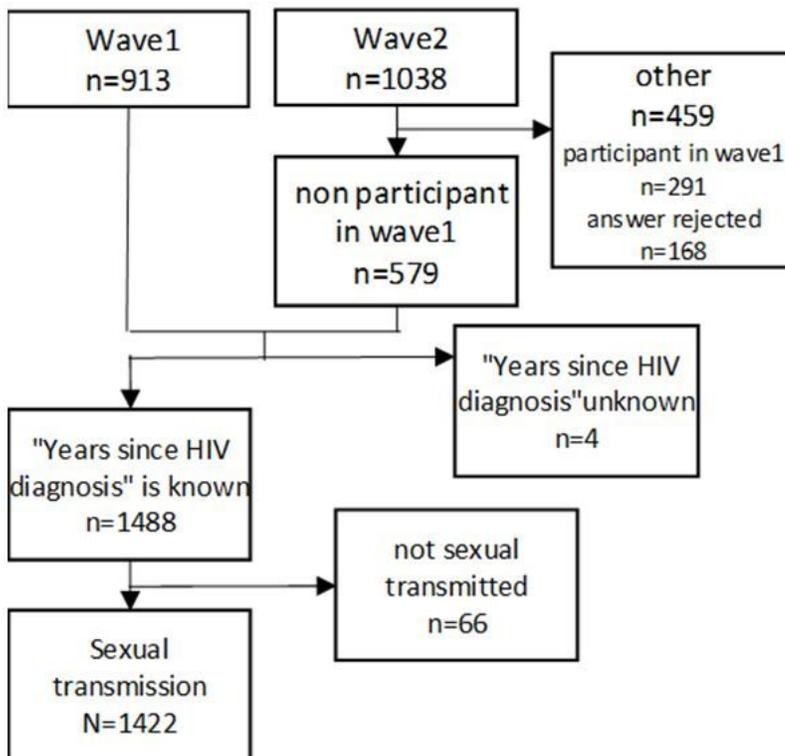


Figure 1

Flow chart of participants in this study.