Four recovery patterns from the Hanshin-Awaji Earthquake: Using the 2001-2003-2005 panel data

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ABSTRACT

We examined panel data (N=297) to evaluate changes in the victim's feeling of recovery after the Great Hanshin-Awaji Earthquake. Then, based on six-years data, we determined the transition pattern of the victim's feeling of the long-term life recovery. We classified the change in the victim's feeling of life recovery into four patterns: ++ type, +type, - type, and -- type.

1. INTRODUCTION

1.1 Problem

A number of large-scale natural disasters have taken place around the world in recent years. We attempted to distinguish which types of process were taken and which types of social factors supported life recovery. In addition, we attempted to distinguish which types of victim were able to recover relatively early and which types of victim needed a longer time for recovery. Understanding the process by which victims recover from large-scale disasters is valuable for providing support guidelines for future victims.

To clarify the mechanism of victim's long-term life recovery, it is necessary to trace changes in the victim's behavior or consciousness over a long period of time after a disaster. However it is extremely difficult to trace victims having various attributes in a longitudinal manner.

Studies on the mechanism of victim's life recovery can be classified into four groups. 1. Detailed ethnographic research on victims in the Hanshin-Awaji Earthquake (which clarifies the disaster process in 10, 100, and 1000 hours after the occurrence of the earthquake)[1]. 2. Research on qualitative and quantitative change of the experience of victims over the 4 years following the Hanshin-Awaji Earthquake by continuous observation of the same victim examinees[2]. 3. Researches on long-term recovery of self-employed workers of medium and small companies who were victims of a hurricane in the United States[3, 4]. 4. Researches of comparison and analysis of life recovery based on large-scale social surveys targeting victims of the Hanshin-Awaji Earthquake[5-9].

These studies are problematic. In Category 1, the long-term recovery process of victims more than 1000 hours after the disaster needs to be clarified, and in Category 2 where a four-year recovery process was tracked, longer-term change in the victim's life recovery should be studied. The researches in Category 3 did not analyze life recovery of victims other than self-employed workers, and the researches in Category 4 studied the victim's behavior or consciousness only at a certain time. For these reasons, the mechanism of change in the victim's long-term life recovery should be clarified.

In this study, we used the results of panel surveys[10-14] as data for analysis of the recovery mechanism. Panel surveys show temporal changes in results, since target examinees and survey questions are fixed (to a certain degree) in the surveys. For example, victims were asked repeatedly to answer the survey questions such as how they felt about life recovery, and this allows us to find temporal change of their feelings, i.e. how much and what type of recovery feeling was strengthened, and how many years it took to recover after the disaster.

Clarification of the mechanism of the long-term life recovery of the Hanshin-Awaji Earthquake victims will provide valuable information for supporting future victims of various natural disasters around the world. In addition, clarification of the victim's recovery mechanism prior to the occurrence of a disaster would enable proper indications regarding which victims, in what timing, and for what reason we should start support work in the event of a natural disaster.

1. 2 Preceding studies

In a preceding study on the recovery of Hanshin-Awaji Earthquake victims, a comprehensive examination of local recovery activities in Kobe city in 1999, five years after the earthquake,

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revealed based on the opinions collected in citizen workshops that the following seven factors are necessary for the victims to achieve life recovery from the disaster: 1. Housing, 2. Social Ties, 3. Townscape, 4. Mind and body, 5. Preparedness, 6.Economic/financial situation, and 7.Relation to Government. This is called the Seven Life Recovery Factor Model[15], referred to as the "7-critical element model for life recovery" below.

The panel surveys of life recovery in Hyogo Prefecture, which we used as analysis data in the present study, were conducted based on the 7-critical element model for life recovery. The survey started in 1999, the fifth year after the occurrence of the earthquake, and was conducted again in 2001, 2003, and 2005 (referred to as three survey years), i.e. once every two years for ten years after the earthquake. There have been many preceding studies[5−7] on the life recovery of victims using these panel survey results. There are also other survey researches[8, 9] that used the survey frame of the Hyogo Life Recovery Panel Surveys as a reference.

In a paper published in 2005 in the journal of the Institute of Social Safety Science, Kuromiya, et al.[16] reported their analysis based on the panel data collected in 2001 and 2003 in the Hyogo Life Recovery Panel Surveys. Using a general linear model (GLM) they examined how the life recovery feeling of the victims in 2003 was explained by preceding factors such as the degree of damage, life recovery feeling as of 2001, and 7 life recovery factors. They found that the 7 life recovery factors had a strong influence on the victim's life recovery feeling as of 2003.

To further clarify the mechanism of the long-term life recovery of victims, it is essential to analyze the final results of the Hyogo Life Recovery Panel Surveys that were conducted to trace the victims for the ten years following the disasters.

2. RESEARCH AIM

The aim of this research is to reveal the life recovery of 297 victims based on the answers obtained from the same victims in the life recovery panel surveys that were set in each of the three survey

years. 1. First we tried to find typical patterns in the change of the victim's life recovery feeling. 2. Then we examined social factors that correlated with each change pattern of the life recovery feeling, taking account of the longitudinal panel data characteristics.

To be more specific, we analyzed the results of the Hyogo Life Recovery Panel Surveys made in the three survey years, and extracted the data of the 297 victims observed in each survey year, in order to identify temporal change of their life recovery processes. We clarified how the victim's life recovery feeling changed through these survey years, and how the victim's attitude, recognition, attributes (sex, generation, occupation), and damage (to house) in the 7 personal life recovery factors affected the temporal change of the life recovery feeling.

3. METHOD

3.1 Research outline

In this study, we used the results of the Hyogo Life Recovery Panel Surveys from three survey years. This information was used for examination of the victim's life recovery and for future disaster control, and future measures and policies for recovery and reconstruction.

The panel survey covered the whole area of Kobe City, other areas in South Hyogo, outside Kobe, that experienced a level 7 earthquake on the Japanese earthquake scale, and areas where the gas supply was stopped. The examinees of the survey were male and female adults living in these areas and we employed the stratified 2-stage sampling method, with which we selected ten examinees in each of 330 research sites. Sampling with probability proportional to size was performed on the Basic Resident Register, and 3,300 samples were taken from the three surveys.

As shown in **Fig. 1**, 1,203 samples were selected in the panel survey in 2001 (with a collection rate of 42.1%), among which 486 people agreed to participate in the survey.

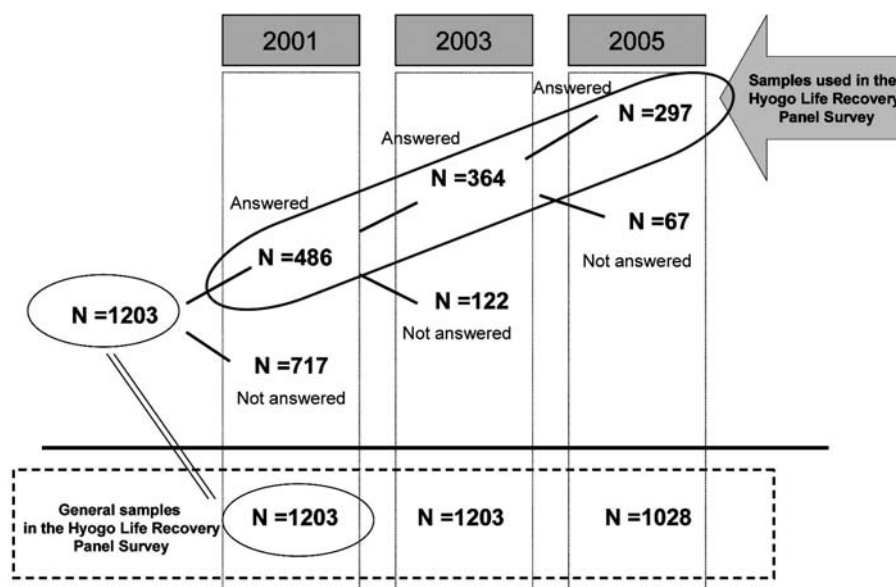In the panel survey in 2003, 364 out of the 486 people who

Fig. 1 Outline of panel survey

participated in the survey in 2001 agreed to participate again. In the panel survey in 2005, a total of 297 people who participated in the preceding surveys in 2001 and 2003 agreed to participate again and answered the questions.

We analyzed the survey results of the 297 people who agreed to participate in the panel survey in 2001 and continued to participate in the successive surveys in 2003 and 2005.

3.2 Frame of panel analysis

From the panel sample data of the Hanshin-Awaji Earthquake victims obtained in 2001, 2003, and 2005, i.e. in the sixth, eighth, and tenth years from the occurrence of the earthquake, we examined how victim's consciousness or attitude changed, how victim's life recovery feeling changed through the three survey years, what type of victim had better or worse life recovery feelings, and whether there is a specific pattern in the temporal change of the life recovery feeling of victims of various attributes.

We also examined how the change of their life recovery was influenced by the victim's basic attributions, the degree of damage to their house in the earthquake, and their recognition or attitude to the 7 life recovery factors.

Fig. 2 shows an image of the panel analysis in the present study. The panel respondents provided their information in the three surveys. They answered the same questions on the induced variable, "ife recovery feeling," repeatedly in the surveys. We clarified how the attributes or housing damage that the victims suffered in 1995, when the earthquake took place, affected the temporal change of their life recovery feeling observed in the three survey years. We also investigated how the temporal change of victim's life recovery feeling reflected the change of the victim's attitude toward the 7 life recovery factors (e.g. Social Ties or Townscape) through the five years from 2001 to 2005, i.e. the sixth to tenth year since the earthquake, and investigated how the temporal change of the life recovery feeling reflected attributes, such as occupation, that the victims had in 2001.

3.3 Measurement of life recovery feeling

The life recovery feeling was measured based on analysis of the data collected in the Hyogo Life Recovery Panel Surveys in 1999, 2001, and 2003. The life recovery feeling was characterized using three sub-indices: (i) the recovery of daily activity, (ii) Life satisfaction and quality of life, (iii) optimistic/pessimistic prospects for the next year.

Questions were set on each of the three sub-indices. Regarding (i) the recovery of daily activity, 7 questions were set on the following items: Busy and active daily life, significance in what you are doing, good relationships with people around you, enjoying daily life, thinking that your future is bright, being healthy and active, and work that you have to do. There were 5 choices to select: From "1. Much increased" to "5. Much decreased." Regarding (ii) Life satisfaction and quality of life, 6 questions were set on the following items: Daily life, health, human relationships, current husbandry, home life, and job. Again, there were 5 choices to select: "1. I'm not satisfied at all" to "5. Yes, I'm very satisfied." Regarding (iii) Prospects for the next year, there was one question set: Do you think that your life will be better next year? To the question, there were 5 choices to select: From "1. Yes, it will be much better" to "5. No, it will be much worse."

The total score for the life recovery feeling was calculated by summing every answer score for the 14 questions, i.e. 7 questions for (i) the recovery of daily activity, 6 questions for (ii) Life satisfaction and quality of life, and 1 question for (iii) optimistic/pessimistic prospects for the next year. The induced variable and the question items are listed in the following table (**Table 1**).s

3.4 Measurement of the victim's basic attributes and the degree of damage to their house

We used attributes such as sex, generation, occupation, and damage (damage to house). In the final analysis, the house damage was characterized by 4 categories: 1. Completely destroyed or completely burned down, 2. Half destroyed or half burned down, 3. Partially destroyed, and 4. No damage.
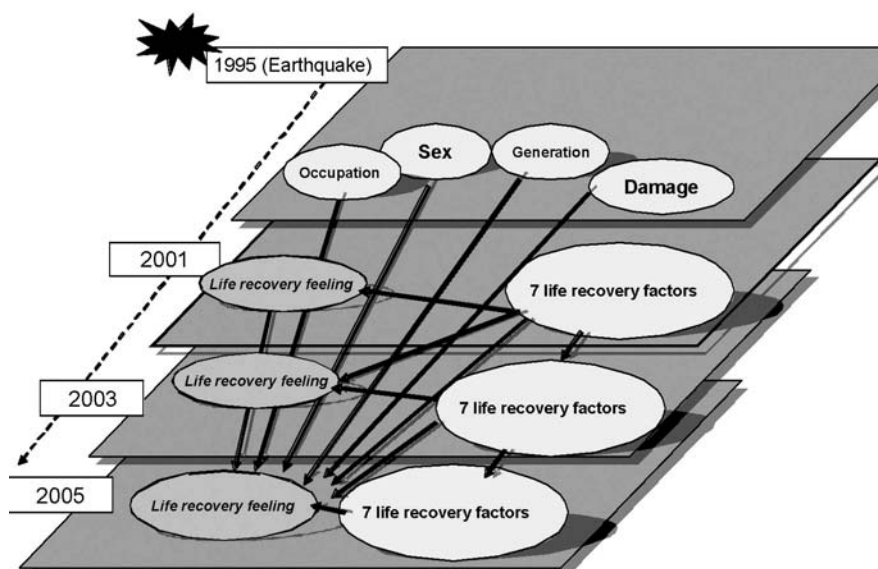

Fig. 2   Analysis frame of panel survey (Schematic diagram)

Table 1. List of question items for life recovery feeling

Q.26 Are the following items increased (enhanced) or decreased (reduced) after the earthquake?
  1. Busy and active daily life
  2. Significance in what you are doing
  3. Good relationships with people around you
  4. Enjoying daily life
  5. Thinking that your future is bright
  6. Health and activity
  7. Work that you have to do

Q.28 Are you satisfied with the following?
  1. Daily life
  2. Health
  3. Human relationships
  4. Current husbandry
  5. Home life
  6. Job

Q.30 Do you think that your life will be better next year?

Table 2. Measurement of life recovery factors (7 life recovery factors)

7 life recovery factors	Index
1. Housing	Type of Housing
2. Social Ties	Civic Mindedness, social trust, family cohesion and adaptability
3. Townscape	Awareness of Urban Commons, neighborly companionship Community participation
4. Mind and body	Physical and mental stress symptom checklist, human damage
5. Preparedness	Preparation (republic)
6. Economic/financial situation	Household budget, household income, occupation
7. Relation to Government	Individual payment for public goods (WTP)

3.5 Measurement of life recovery factors

Explanatory variables that were considered to have some influence on the life recovery feeling are listed in **Table 2**. We here explain them in the order of the 7 life recovery factors.
(1) Housing

Resident status (owned house, owned apartment, private rental apartment, public housing) was asked about.
(2) Social Ties

To reveal social ties, we used 8 question items on social reliability, 13 items on recognition of civic mindedness, and 2 items on family relationships. The social reliability scale proposed by Yamagishi17) was used for the 8 items on social reliability such as "basically, most people are honest," "I tend to trust other people," or "people around me take advantage of me [contrary question]." (To each question there were two answers to select: 1. I think so, or 2. I don't think so.) The score for social reliability was determined by the first major item score based on the optimal scale method.

Eight items were used to ask about being a citizen. They were chosen to measure the degree to which each citizen was self-ruling from the two viewpoints of "autonomy" and "solidarity." We used the optimal scale method for these 8 question items but failed to separate the two components, autonomy and solidarity. So, we used the first major item score as an index of "being a citizen (autonomy and solidarity)."

For family cohesion and adaptability, Tatsuki[18] used 8 Thurstone Scale items (FACESKGIV-16 Version2) to express the degree of family bonds or family steering, based on a circumplex model of the family system. It is assumed in the model that family relationships are the most functional when family bonds and family steering are both at a moderate level. So, we calculated the sum of squared deviation from the answers and used it as the index of family relationships (bond and steering). (Family relationships are less

functional with a larger sum of squared deviation.)

(3) Townscape

As a life recovery factor, "townscape" affects the citizen's activity characteristic, influencing how citizens themselves participate in the town community. Its major elements include actual neighborhood development (e.g. neighborly companionship) and practice of local activities (e.g. participating in town activities or organizing activities). For "townscape," questions were set on the degree of the citizen's awareness of urban commons (e.g. rich greenery, nice parks, pleasant cityscape, etc.)

The optimal scale method was used to calculate a composite score for "neighborly companionship and local activities" from the 4 question items on neighborhood development and 6 items on participation in local activities.

For "attachment to town", we used the optimal scale method to obtain a standardized composite score, and used it as a score for "awareness of urban commons" (feeling of sharing a town to which citizens are deeply attached).

(4) Mind and body

For the index of mind and body, questions on "human damage" were set, asking if victims or their family were injured, became ill, or died in the earthquake disaster.

Six question items were set on victim's mental state in the last one month ("I feel nervous," "I feel lonely," "I feel depressed," "I always think negatively," "I can't concentrate," and "I don't have energy to do anything"). Also, 6 items were set on their physical stress ("I have palpitations," "I have shortness of breath," "I have headaches or a stuffy head," "I have a tight, painful feeling in my chest," "I feel dizzy," and "I have a dry throat"). In response to the questions, there were 5-point Likert-scale answers to select: From "1. No, I don't have it" to "5. Yes, I always have it." We calculated the total score for each question item and used it as the index of mental stress and physical stress.

(5) Preparedness

Questions on "preparedness" were set with 4 themes (rules for putting out garbage, local activities, protecting citizen's lives from disaster, and town development) to ask about people's consciousness of being prepared against disasters. Respondents selected one of three answers: "We should entrust the government with preparation," "We should place priority on freedom and rights," and "We should place priority on resident's autonomy." With the optimal scale method, we found that the "republican characteristic" where people gave priority to the self-ruling of citizens gained the first major item score. We therefore used the score as the index of republican self-ruling or preparation.

(6) Economic/Financial Situation

For living conditions, a question was set on household income with three answer choices: Income "increased," "did not change," or "decreased" due to the earthquake. This answer was used as an index of living conditions (household income).

(7) Relation to Government

The index of individual payment for public goods (Willingness to Pay) was used. Victims were asked how much they were prepared to pay for the maintenance of parks in the neighborhood, local events such as festivals and athletics meetings, and activities of the local community. Based on the collected answers, we made frequency distribution data and classified them into three categories: 0 yen, 999 yen or less, and 1,000 yen or

more. This data was used as an index representing relation to Government.

4. PANEL ANALYSIS RESULTS AND DISCUSSION

4.1 Panel samples and general samples: Study on attribution dependency

Kitamura[10] pointed out that the actual problem in panel surveys was the fact that, as the survey was conducted repeatedly, the number of survey samples decreased and hence a distorted correlation among samples could appear, compared with the sample population collected in the first survey.

We therefore compared a fraction of 297 respondent samples of various attributes to that of general samples in 2001, 2003, and 2005. It is important to obtain basic information such as the attributes of the 297 respondents. The items used in the comparison were 1. Sex, 2. Generation, 3. Occupation, and 4. Housing damage.

In the following, we show the results of the comparison for each attribute between 297 panel respondents and general respondents in the three surveys.

The panel respondents (N=297) of the research target had overall characteristics such as: 1. Sex: There were more male respondents than female respondents. 2. Generation: There were few people in their twenties at the time of the earthquake, while there were a number of the victims who were in their fifties or sixties. 3. Housing damage: Many respondents had their houses completely destroyed or burned down. We show below sample proportions of each attribution.

(1) Sex

With regard to sex, we found no statistically significant difference between the panel respondents (N=297) and general respondents in 2001 (N=1,203) (χ^2=2.598, df=1, N. S) or those in 2003 (N=1,203) (χ^2=1.439, df=1, N. S). However, the comparison with the general respondents in 2005 (N=1,028) showed a statistically significant difference (χ^2=5.152, df=1, P< .05).

As shown in **Fig. 3**, male respondents comprised 51.5% of the panel respondents but only 44.1% of the general respondents in 2005. Female respondents comprised 48.5% of the panel respondents while they comprised 55.9% of the general respondents. We thus found that there were slightly more males than females in the panel respondents.

(2) Generation

With regard to generation, there were statistically significant differences in the comparison of the panel respondents (N=297) with the general respondents in 2001 (N=1,203) (χ^2=25.930, df=5, P< .01), with those in 2003 (N=1,203) (χ^2=16.925, df=5, P< .01), and with those in 2005 (N=1028) (χ^2=19.709, df=5, P< .01).

As shown in **Fig. 4**, there were fewer panel respondents at the age of 29 or younger than general respondents in the same generation, while there were more panel respondents in their fifties or sixties than in the general respondents in the same generations.

(3) Occupation

With regard to occupation, we found a statistically significant difference between the panel respondents (N=297) and the general respondents in 2001 (N=1,203) (χ^2=18.620, df=9, P< .05). However, there was no statistically significant difference found in the comparison with those in 2003 (N=1,203) (χ^2=7.914, df=9, N.
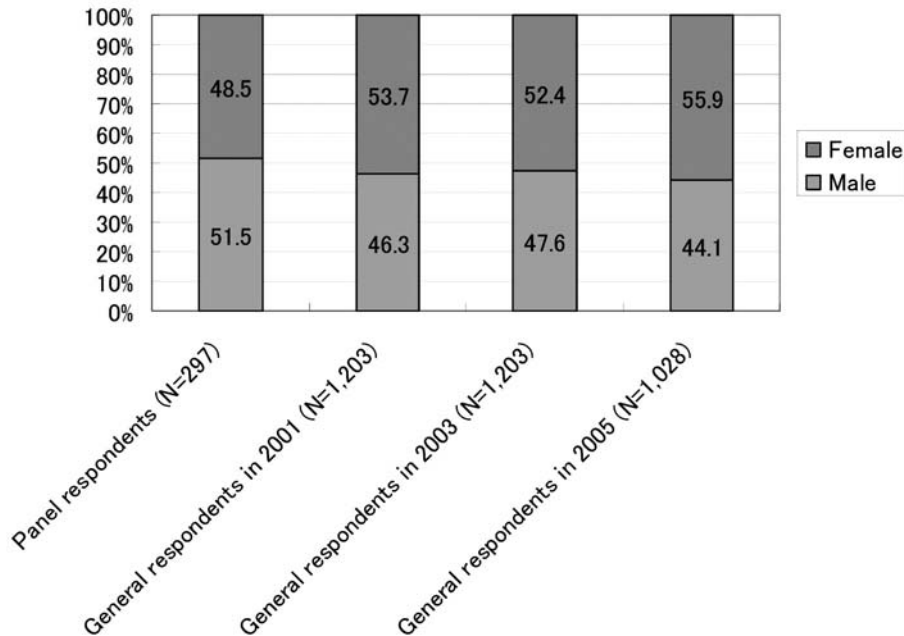
Fig. 3. Comparison of sex proportion between panel respondents and general respondents of 2001, 2003 and 2005.
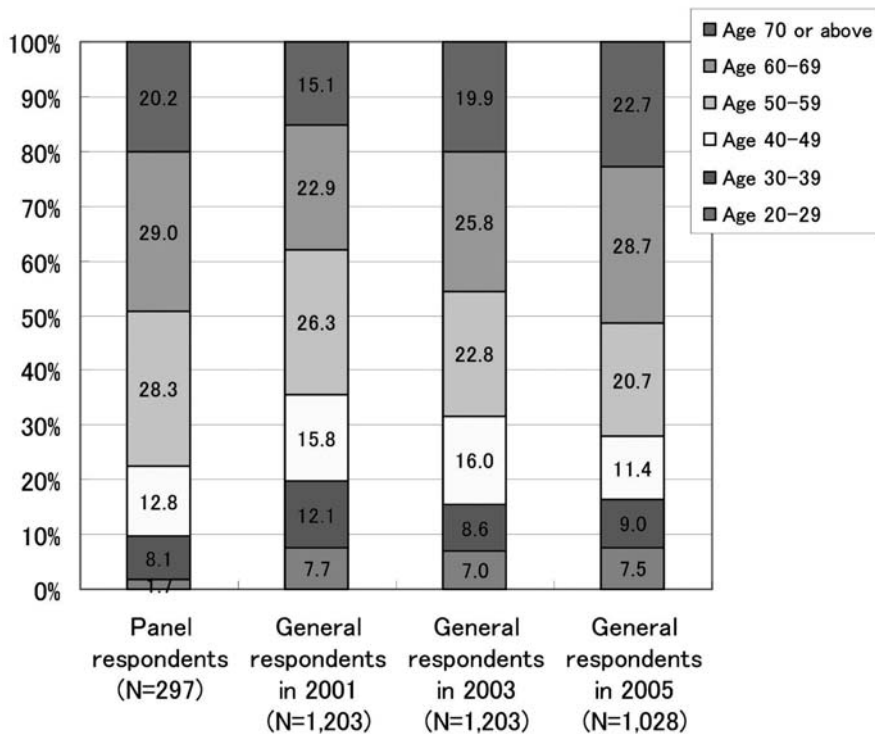

Fig. 4. Comparison of generation proportion between panel respondents and general respondents of 2001, 2003 and 2005.

S) or with those in 2005 (N=1,028) (χ^2=11.309, df=9, N. S).

It was characteristic that the proportion of those who had no job or received pensions was high in the panel respondents (37.2%). (See **Fig. 5**.)

(4) Housing damage

With regard to housing damage, there were statistically significant differences in the comparison of the panel respondents

(N=297) with the general respondents in 2001 (N=1,203) (χ^2=9.059, df=3, *P*< .05), with those in 2003 (N=1,203) (χ^2=8.324, df=3, *P*< .05), and with those in 2005 (N=1,028) (χ^2=12.195, df=3, *P*< .01).

Those who had their houses completely destroyed or burned down comprised 22.9% of the panel respondents, which is a higher proportion compared to the general respondents. There were many
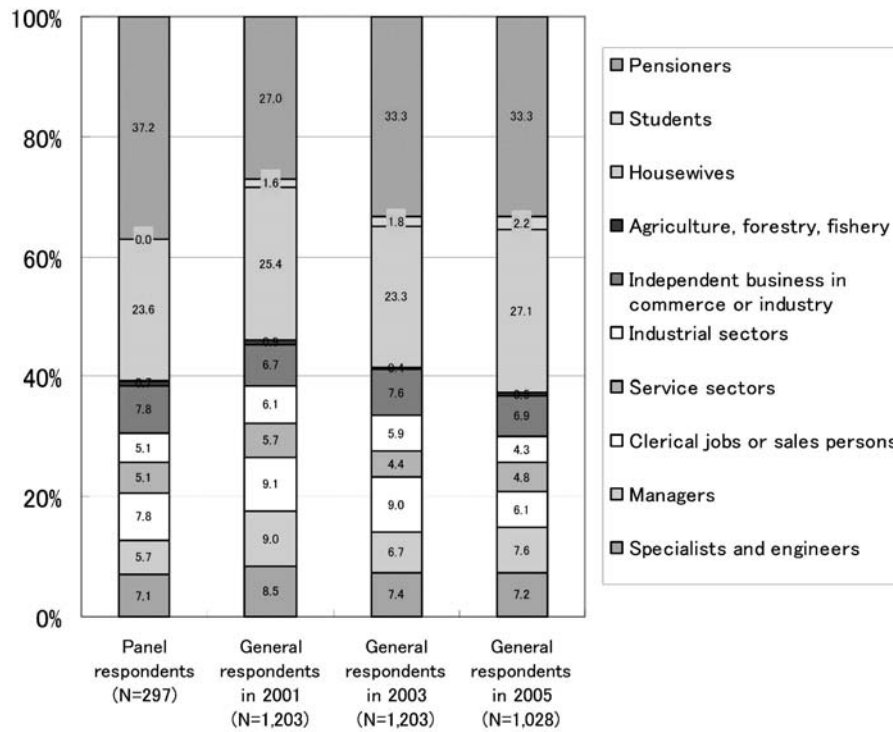
Fig. 5. Comparison of occupation proportion between panel respondents and general respondents of 2001, 2003 and 2005.
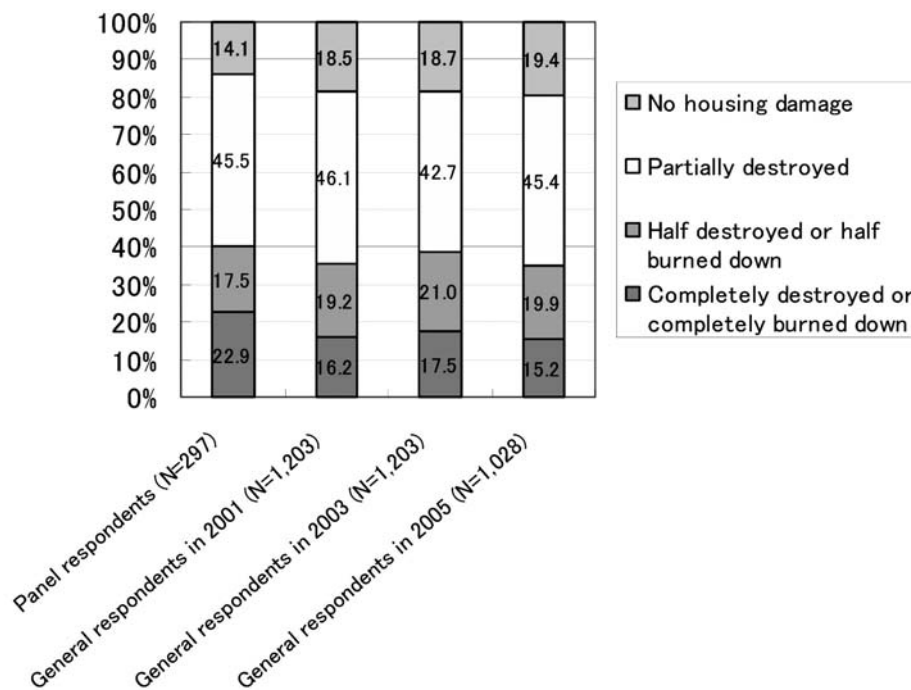

Fig. 6. Comparison of occupation proportion between panel respondents and general respondents of 2001, 2003 and 2005.

panel respondents who had relatively major damage to their houses. (See **Fig. 6**.)

4.2 Score distribution of life recovery feeling in 2001, 2003 and 2005

To identify the overall tendency of the life recovery feeling of the 297 panel respondents, we compared the score distributions obtained in the 2001 survey, 2003 survey and 2005 survey. (See **Fig. 7**.)

To be more specific, we calculated the scores of the answers to the 14 questions on the life recovery feeling in every survey and used them as each year's life recovery feeling scores to broadly

Year 2001: Average 41.4, Standard deviation=8.71
Year 2003: Average 41.1, Standard deviation=9.07
Year 2005: Average 41.5, Standard deviation=9.97

Higher score indicates stronger life recovery feeling.

One-way analysis of variance in the repeated measurements (F (2,297)=0.505, NS)

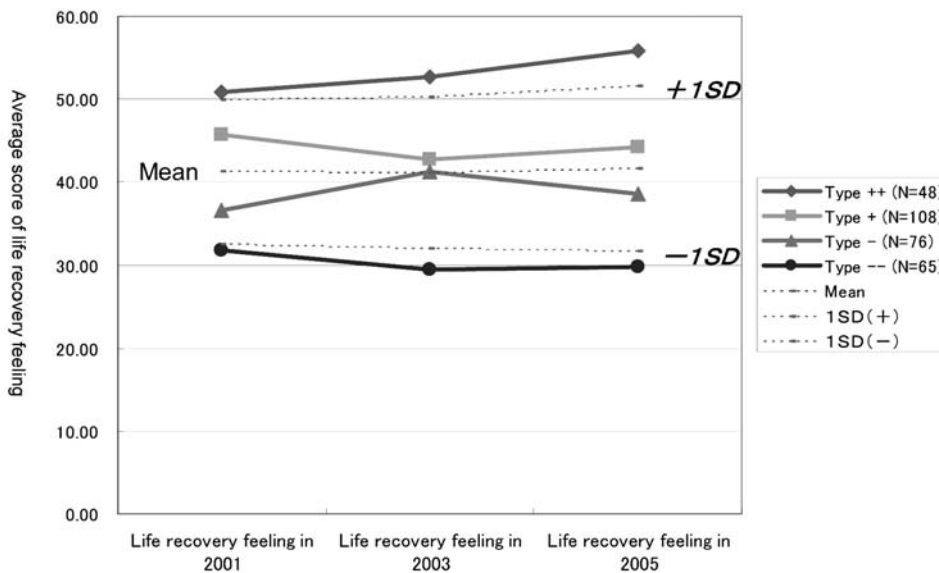**Fig. 7** Score distribution of life recovery feeling in three surveys

Fig. 8 Four life recovery change patterns in the three surveys (N=297)

reveal how the scores of the 297 panel respondents changed through the three surveys.

We found no statistically significant difference in the average scores of the life recovery feeling in the three surveys (using one-way analysis of variance in the repeated measurements (F (2,297)=0.505, NS)). In other words, the average score for the life recovery feeling did not change through the three surveys.

Next we made two-step analysis: 1. Was there any change in the pattern of the life recovery feeling of the 297 victims through the three surveys? 2. To what extent did the life recovery feeling

factors have a direct correlation with the change pattern? Based on this analysis, we tried to clarify the life recovery mechanism of the victims.

4.3 Four typical patterns in the change of life recovery feeling: Characterization of life recovery feeling patterns with cluster analysis

We made detailed analysis of the score change of the life recovery feeling of the 297 panel respondents, and looked for typical patterns of the change by examining what type of victims had
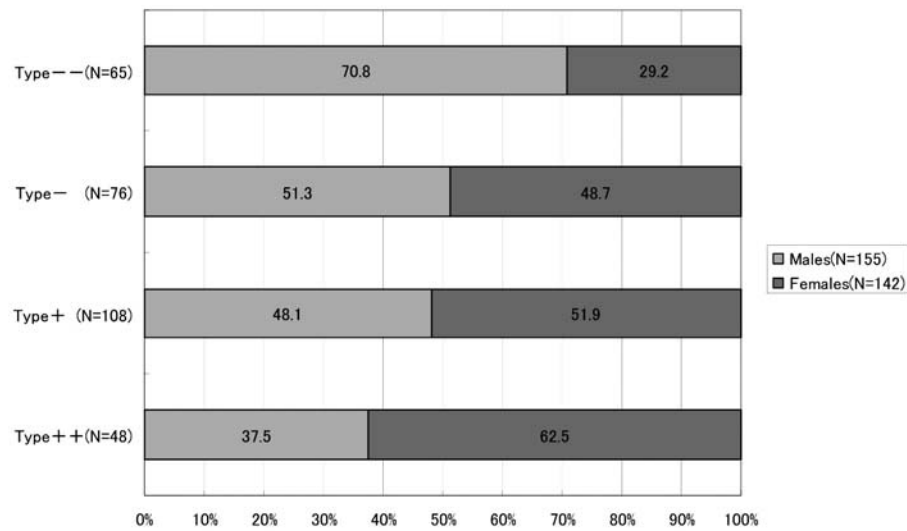
Fig. 9 Results of cross tabulation analysis on the relation between sex and the 4 recovery patterns

their life recovery feeling strengthened or weakened through the years 2001, 2003, and 2005.

To determine typical patterns of the score change, we performed cluster analysis (analysis to find respondents who gave similar answers) of the change in the scores of the life recovery feeling that were found in the respondent's answers. Cluster analysis is an analysis method for finding typical change patterns of similar answers. For example, respondents who had a strong life recovery feeling in the three surveys in 2001, 2003, and 2005, were classified as a pattern of strong life recovery. On the other hand, those who had very weak life recovery feeling were classified as a pattern of weak life recovery. We thus used cluster analysis to classify the score change of the life recovery feeling in the sixth, eighth, and tenth year since the earthquake, and determined the long-term recovery pattern of the victims.

In the cluster analysis according to the Ward method using squared Euclidean distance, the change of the life recovery feeling of the 297 victims could be clearly classified into the four typical patterns of life recovery feeling as shown in **Fig. 9**.

By examining the average score change, we found four significantly different patterns in the change of the victim's life recovery feeling during the period from the sixth to the tenth year since the earthquake (in the one-way analysis of variance in the repeated measurements ($F_{(3,293)}=458.287$, $P< .01$)).

Detailed analysis of each pattern indicates a major characteristic that the change patterns of the life recovery feeling do not intersect with each other and exhibited stable scores in the series of surveys. Namely, the victim's life recovery feeling was maintained with the average score showing stable behavior during the period from the sixth to the tenth year since the earthquake. Victims who had a relatively strong life recovery feeling (stronger by more than +1 standard deviation or stronger than the average) in the sixth year since the earthquake, also had a strong life recovery feeling in the tenth year. On the other hand, victims who had a relatively weak life recovery feeling in the sixth year, also had a weaker recovery feeling than the others in the tenth year. These results suggest that, by examining the life recovery scores as of 2001, the sixth year

Table 3. Four life recovery change patterns and relevant factors (Summary of cross tabulation)

	Pearson's χ^2	df	P	
Sex	13.87	3	0.00	***
Occupation (2001)	38.03	21	0.01	**
Occupation (2005)	38.92	24	0.03	**
Human Damage	6.62	3	0.09	*
Damage to household belongings	16.36	9	0.06	**
Housing Resident status (2005)	37.78	21	0.01	**
Civic Mindedness	23.17	9	0.01	**
Social Trust	32.84	9	0.00	***
Awareness of Urban Commons	19.78	9	0.02	**
Physical Stress	79.83	9	0.00	***
Mental Stress	58.50	9	0.00	***
Household Annual Income (2005)	38.48	6	0.00	***
Work Place Damages From Disaster	8.58	3	0.04	**

since the earthquake, the life recovery feeling of the victims can be predicted for subsequent years.

We call the four patterns "Type ++," "Type +," "Type -," and "Type --," respectively in descending order of the life recovery scores.

4.4 Victim's attributes, damage to house, and 7 life recovery factors in the 4 change patterns

Next, we analyzed typical victims in each life recovery change pattern by making a cross tabulation. **Table 3** shows the results of the tabulation.

The factors relevant to the 4 change patterns of the life recovery feeling were "sex" and "occupation (in 2001 and 2005)" of the attributes. With regard to damage, "human damage" and "damage

to household belongings" were found to be relevant. Among the 7 life recovery factors, "resident status (as of 2005)" of the housing index, "civic mindedness" and "social trust" of the social ties index, "awareness of urban commons" of the townscape index, "physical stress" and "mental stress" of the mind and body index, and "household income (in 2005)" and "harm to work place in the earthquake damage" of the economic/financial situation index were relevant to the 4 change patterns of the life recovery feeling.

On the other hand, we found no relevance of the factors "preparedness" or "relation to government" to the patterns. This is probably because consciousness regarding preparation against disaster became relatively low in the long-term recovery process of victims. Also, the irrelevancy of the relation to government might be explained by considering that the victim's consciousness of paying money for various civic amenities in their lives had become lower than that shortly after the earthquake. We consider that the

factors closely related to the lives of the victims in the long-term are relevant to the 4 change patterns of the life recovery feeling.

In the following, we show the results of the cross tabulation analysis with typical factors that were found relevant to the 4 life recovery feeling change patterns.

(1) Attributions: Relation of sex and occupation with the 4 recovery patterns

We found a strong correlation between sex and the 4 change patterns of the life recovery feeling (χ^2=13.87, df=3, P< .01). There were more females (62.5%) than males in Type ++ of the recovery pattern, while there were more males (70.8%) than females in Type -- (**Fig. 9**). The high proportion of males in Types -- and - could be because the percentage of those having a job was higher among males than among females.

We also found a strong relevance between occupation and the

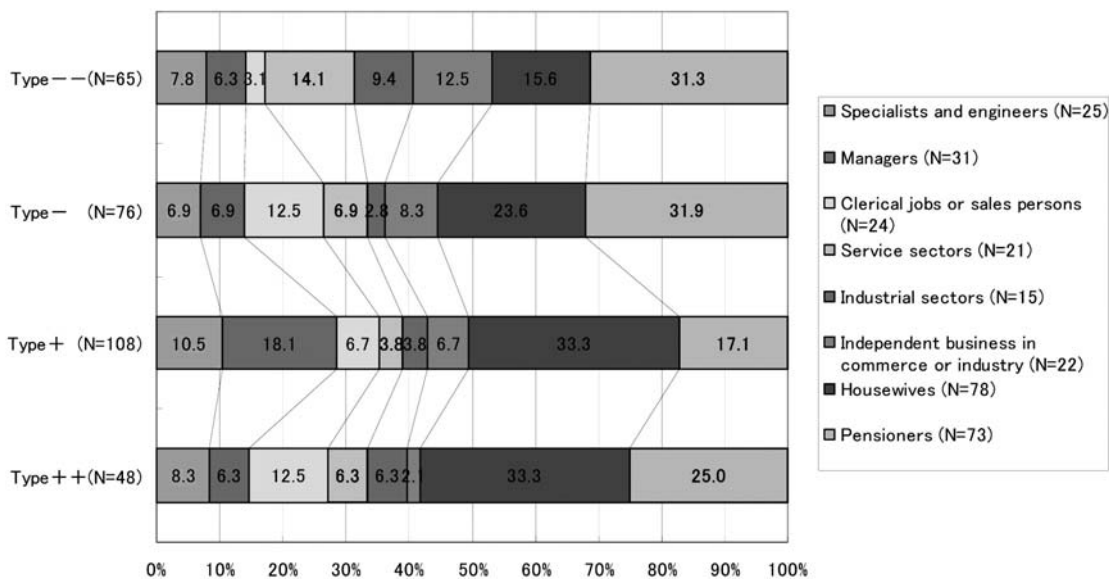**Fig. 10** Results of cross tabulation analysis on the relation between occupation and the 4 recovery patterns
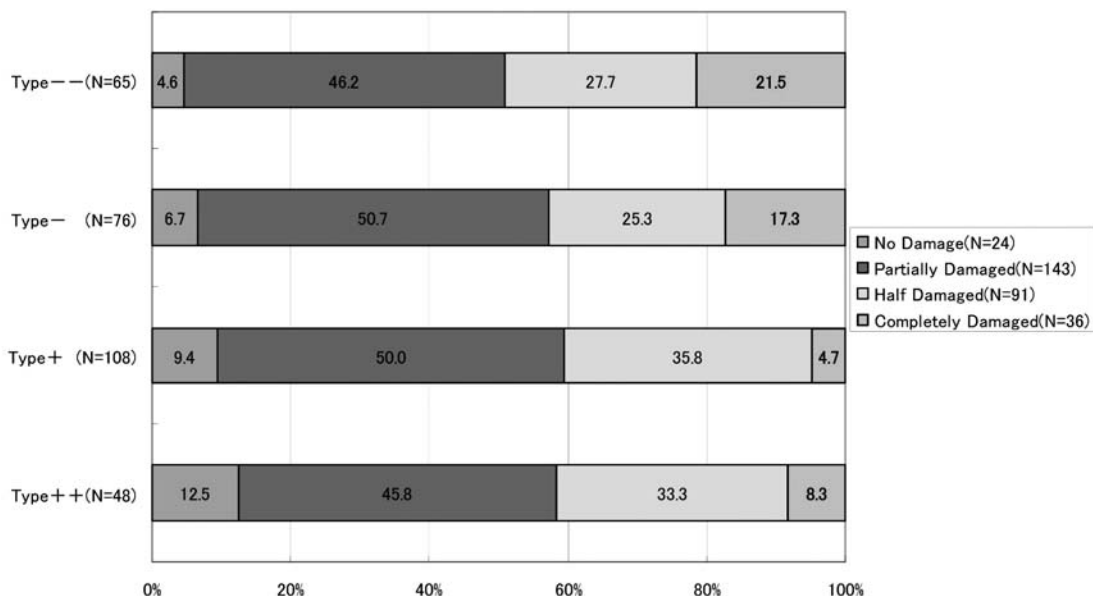

Fig. 11 Results of cross tabulation analysis on the relation between damage to household belongings and the 4 recovery patterns

4 life recovery feeling patterns (χ^2=38.03, df=21, *P*< .01). The study on the correlation between victim's occupation as of 2001 and the 4 recovery patterns showed that housewives (33.3%) and clerical jobs or sales persons (12.5%) dominated in Type ++, managers (18.1%) dominated in Type +, and independent business persons (12.5%) dominated in commerce or industry and workers in service sectors (14.1%) dominated in Type --. (See **Fig. 10**.) In other words, the number of victims who had jobs in the local disaster areas was relatively high in Type --.

(2) Damage: Relation of damage to household belongings with the 4 recovery patterns

We found a certain correlation between the degree of earthquake damage to household belongings and the 4 change patterns of the life recovery feeling (χ^2=16.36, df=9, *P*< .1).

Those who had household belongings damaged in the earthquake were mostly found in Type -- (21.5%). As the victims had a special feeling for the belongings, damage to household belongings had a major influence on human damage and showed a strong correlation with the 4 recovery patterns (**Fig. 11**).

(3) 7 life recovery feeling factors: Relations of 7 life recovery feeling factors with the 4 recovery patterns

(i) Residential status (Relation of residential status with the 4 recovery patterns)

We found a significant statistical relevance between residential status as of 2005 and the 4 change patterns of the life recovery feeling (χ^2=37.78, df=21, *P*< .01).

The proportion of victims who lived in public housing was relatively high (12.5%) in Type --, compared to the other types, while the proportion of those who lived in an owned house on owned land was high (75.8%) in Type ++. There could have been many victims who had lived in public housing before the earthquake and had to move to other places after the disaster. This indicates that housing was an important factor in the life recovery. (See **Fig. 12**.)

(ii) Civic Mindedness (Relation of civic mindedness, an index of human connections, with the 4 recovery patterns)

We found a strong correlation between the change in the consciousness of civic mindedness from 2001 to 2005 and the 4 change patterns of the life recovery feeling (χ^2=23.17, df=9, *P*< .01). The proportion of the victims who had an autonomous character cooperating with others (i.e. who had a stronger character as citizens) was high in Type ++, while the proportion of those who had a weaker character as citizens was high in Type --. (See **Fig. 13**.)

(iii) Awareness of Urban Commons (Relation of awareness of awareness of urban commons, an index of townscape, with the 4 recovery patterns)

We found a certain correlation between the change in the awareness of civic amenities from 2001 to 2005 and the 4 change patterns of the life recovery feeling (χ^2=19.78, df=9, *P*< .05).

The proportion of the victims who had a special feeling for shared goods (urban commons) in a town was high in Type ++, while the proportion of those who did not have such special feeling was high in Type --. In other words, those who had strong pride in their town because of nice parks, cityscape that they liked, places where everyone gathered, etc, were mostly found in the pattern type of positive life recovery feeling (**Fig. 14**).

(iv) Mental stress (Relation of mental stress, an index of mind and body with the 4 recovery patterns)

We found a strong correlation between the change in mental stress from 2001 to 2005 and the 4 change patterns of the life recovery feeling (χ^2=58.50, df=9, *P*< .001).

The proportion of victims who had constantly high mental and physical stress in the period from 2001 to 2005 was high in Type -- (**Fig. 15**). Those who could relieve their stress were mostly found in Type ++ or Type +. This indicates a strong relevancy between victim's stress and the long-term change of the life recovery feeling.

(v) Change of household income (Relation of the change in household income in 2005, an index of living conditions, with the 4 recovery patterns)
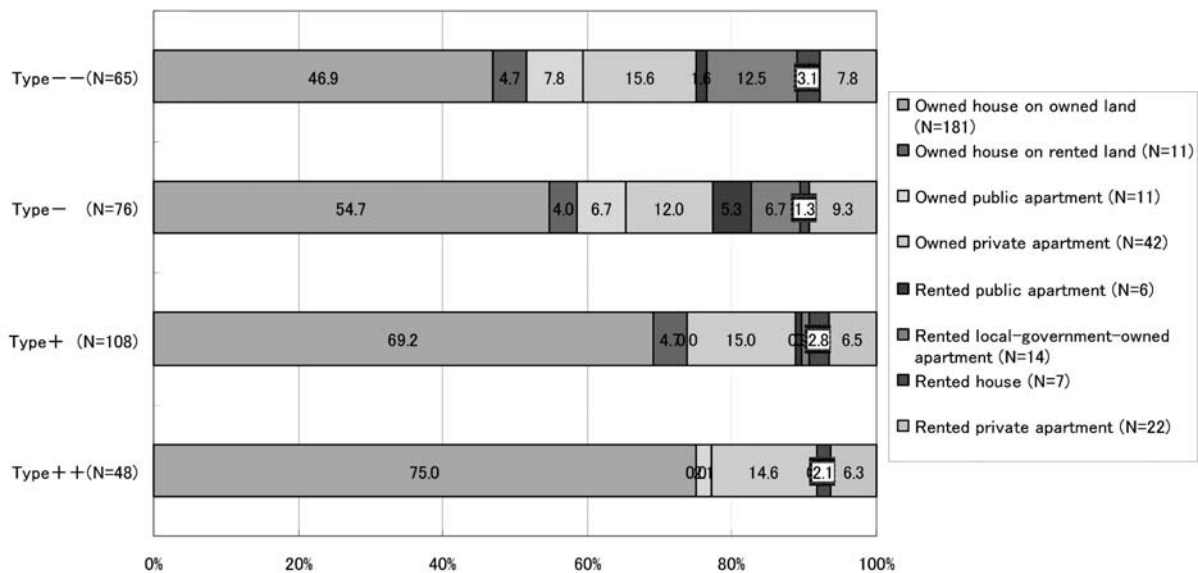

Fig. 12 Results of cross tabulation analysis on the relation between residential status as of 2005 and the four recovery patterns

We found a strong correlation between the change in household income and the 4 change patterns of the life recovery feeling (χ^2=58.50, df=9, P< .01).

The proportion of the victims who answered that their household income as of 2005 increased after the earthquake was high in Type ++, while the proportion of those who answered that their income decreased was high in Type -- (**Fig. 16**). Change in household income after the earthquake had a strong relevancy to the 4 life recovery feeling patterns, as it was an important, basic factor in victim's lives.

The above analysis of the panel survey reveals the life recovery process of the victims, which is summarized in **Fig. 17**. The figure, a summary of the analysis results, presents an image of the victims in each typical pattern of the life recovery feeling.

5. MEASURES FOR VICTIMS IN THE LIFE RECOVERY PATTERN TYPE -

The aim of this study was to clarify the mechanism of the long-term life recovery of the victims and observe what type of
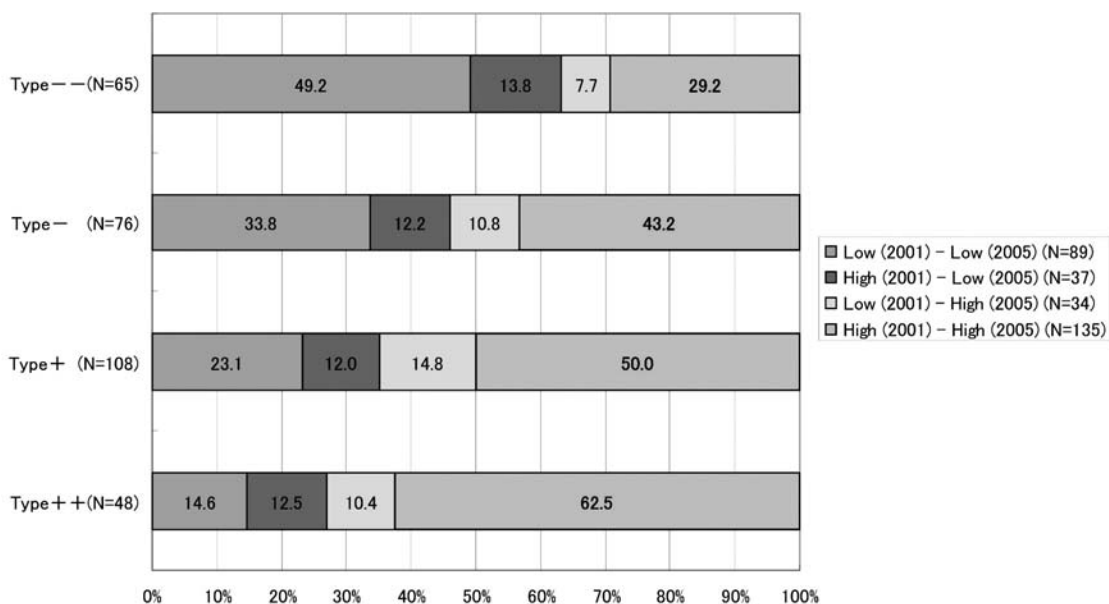
Fig. 13 Results of cross tabulation analysis on the relation between the change in the consciousness of civic mindedness from 2001 to 2005 and the four recovery patterns
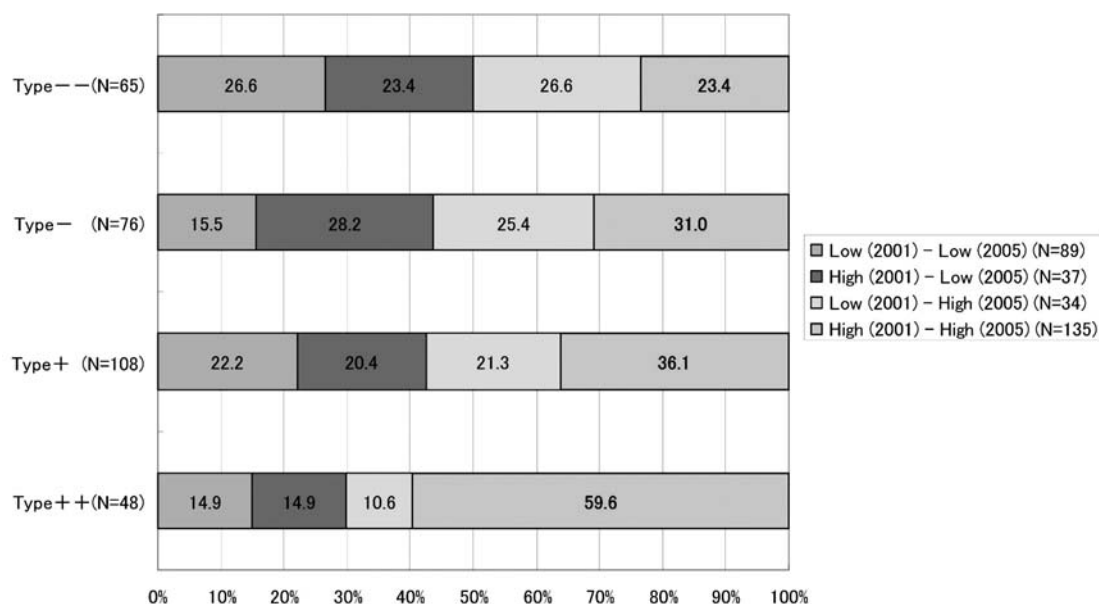
Fig. 14 Results of cross tabulation analysis on the relation between the change in the awareness of urban commons from 2001 to 2005 and the four recovery patterns
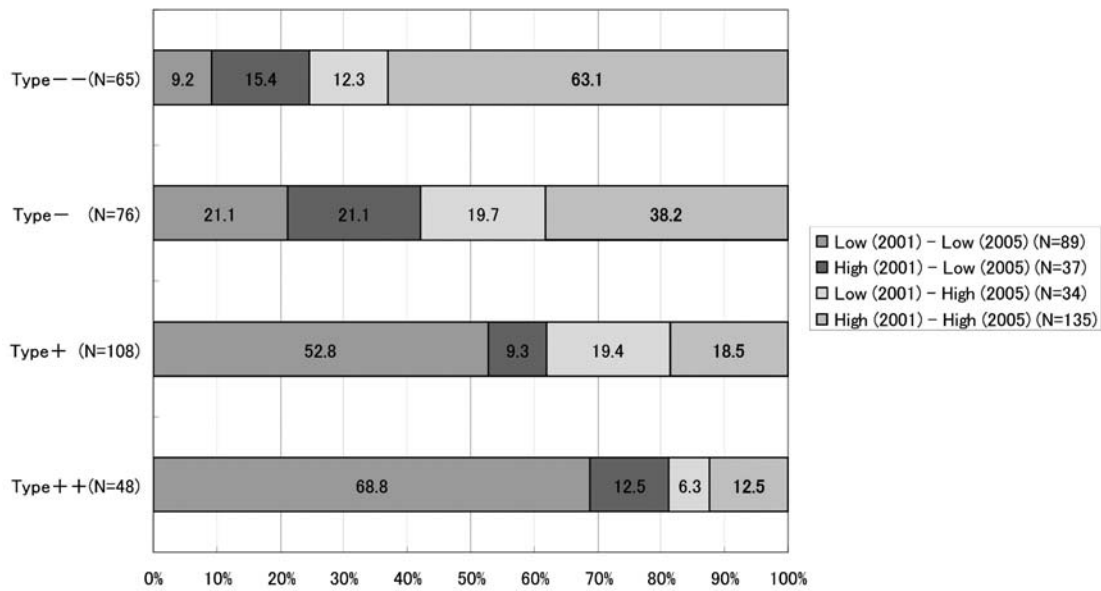
Fig. 15 Results of cross tabulation analysis on the relation between the change in mental stress from 2001 to 2005 and the four recovery patterns

Fig. 16 Results of cross tabulation analysis on the relation between the change in household income and the four recovery patterns

victims had difficulty in the recovery. Based on this study we could prepare appropriate, effective long-term support plans for the earthquake victims.

The results of the analysis show that long-term support measures are necessary in particular for victims of Type -- who had the lowest scores of the life recovery feeling in the three surveys.

Examining the between-class variation of the 4 life recovery feeling change patterns, we found that the average life recovery feeling score for 65 victims of Type -- fell in the period from 2001 to 2003 (*P*< .01) but stopped falling in the period from 2003 to 2005 (N.S). (See **Fig. 18** and **Table 4**.)

The fact that the average score stopped falling in the period from 2003 to 2005 indicates that some victims of Type -- had their

life recovery feeling strengthened and some had it weakened in this period. What stopped the fall in the life recovery feeling score? We used one-way analysis of variance in the repeated measurements to find the cause of the different effects (interaction effects) among the victims in the time variance.

The analysis reveals the following causes that stopped the fall of the life recovery feeling score for the Type -- victims.

(i) "The number of times the person changed house after the earthquake": The victims of Type -- who changed house after the earthquake 0, 2, or 3 times as of 2001 had a life recovery feeling score at the same level or slightly enhanced in the period from 2003 to 2005. On the other hand, those who changed house 4 times as of 2001 had a dramatically lower life recovery

Stronger life recovery feeling (+)

Type ++

Attributes
- Female   -Housewife, clerical job/sales person
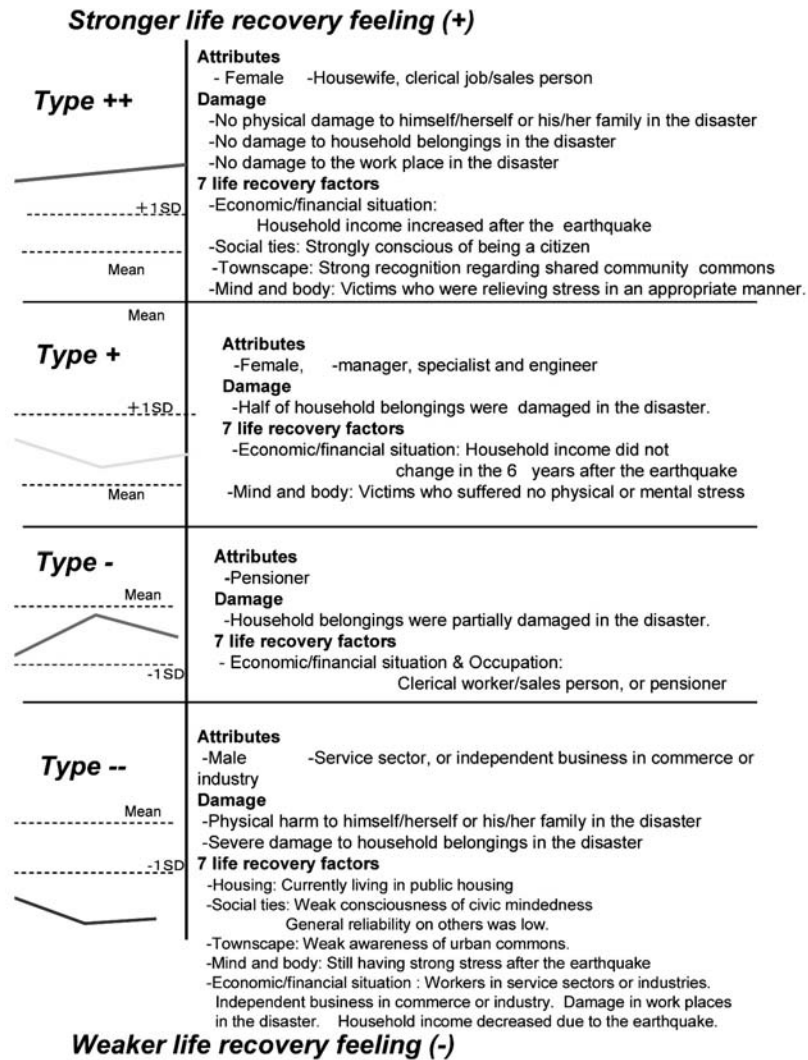
Damage
-No physical damage to himself/herself or his/her family in the disaster
-No damage to household belongings in the disaster
-No damage to the work place in the disaster

7 life recovery factors
-Economic/financial situation:
        Household income increased after the earthquake
-Social ties: Strongly conscious of being a citizen
-Townscape: Strong recognition regarding shared community commons
-Mind and body: Victims who were relieving stress in an appropriate manner.

±1SD

Mean

Mean

Type +

Attributes
-Female,   -manager, specialist and engineer

Damage
-Half of household belongings were damaged in the disaster.

7 life recovery factors
-Economic/financial situation: Household income did not
               change in the 6 years after the earthquake
-Mind and body: Victims who suffered no physical or mental stress

±1SD

Mean

Type -

Attributes
-Pensioner

Damage
-Household belongings were partially damaged in the disaster.

7 life recovery factors
- Economic/financial situation & Occupation:
           Clerical worker/sales person, or pensioner

Mean

-1SD

Type --

Attributes
-Male   -Service sector, or independent business in commerce or industry

Damage
-Physical harm to himself/herself or his/her family in the disaster
-Severe damage to household belongings in the disaster

7 life recovery factors
-Housing: Currently living in public housing
-Social ties: Weak consciousness of civic mindedness
           General reliability on others was low.
-Townscape: Weak awareness of urban commons.
-Mind and body: Still having strong stress after the earthquake
-Economic/financial situation : Workers in service sectors or industries.
  Independent business in commerce or industry. Damage in work places
  in the disaster. Household income decreased due to the earthquake.

Mean

-1SD

Weaker life recovery feeling (-)

Fig. 17   Image of victims in the four life recovery feeling change patterns (Summary)

Change pattern of life recovery feeling

— Type ++(N=48)

— Type +(N=108)

— Type - (N=76)

Type -- (N=65)

P<.05

P<.10

P<.001

NS

P<.001

P<.05

P<.01

NS

Mean score of life recovery feeling

60.00

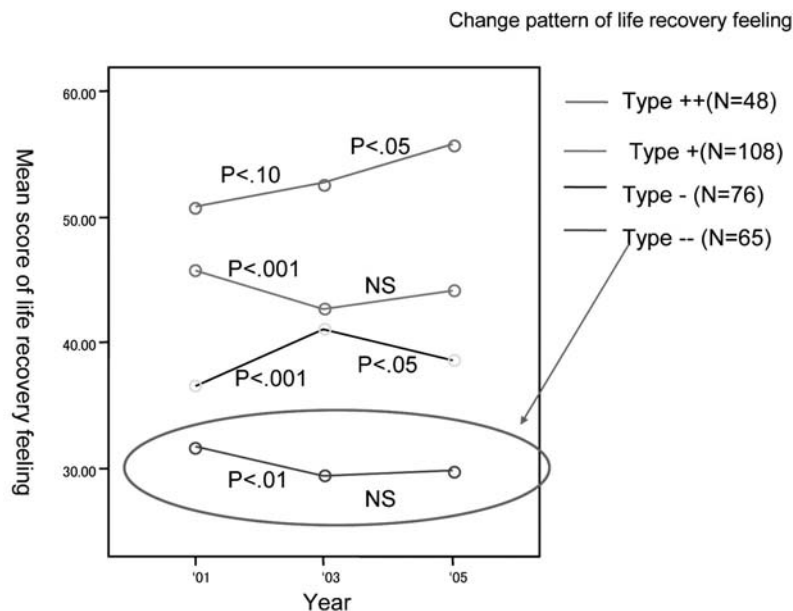50.00

40.00

30.00

'01   '03   '05

Year

Fig. 18   Change of average score for each recovery pattern (Between-class variation)

Table 4. Between-class variation of life recovery feeling of Type -- victims in the three surveys (From one-way analysis of variance in repeated measurements)

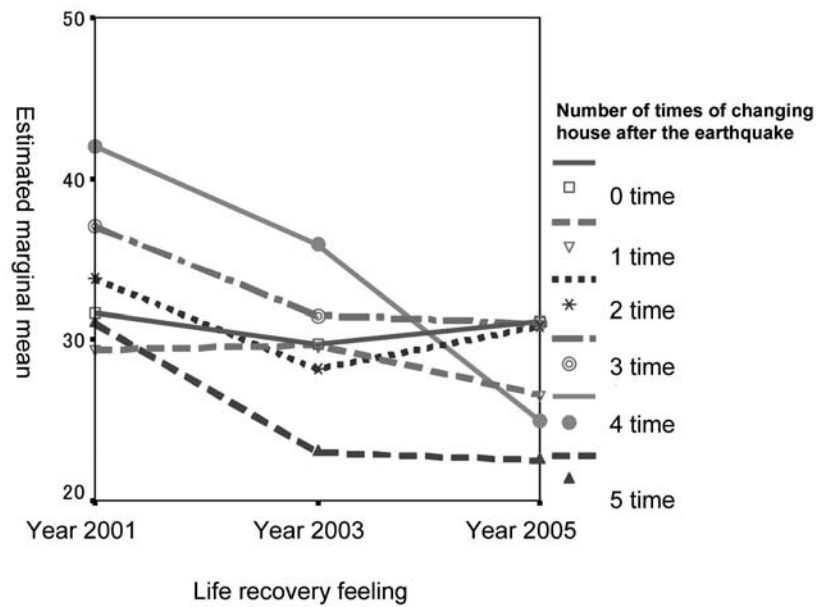|	Period	Square sum of type III	Degree of freedom	Mean square	F-value	Significance probability
Time	2001 vs. 2003	329.341	1	329.341	7.714	0.007
	2003 vs. 2005	6.796	1	6.796	0.175	0.677
Error (time)	2001 vs. 2003	2732.397	64	42.694		
	2003 vs. 2005	2484.324	64	38.818		

Fig. 19 Number of times of changing house of Type -- victims after the disaster, and change of average scores of the life recovery feeling through the three surveys

Table 5. The influence of the number of times of changing house after the earthquake on the life recovery feeling of Type -- victims (Between-class variation: one-way analysis of variation in the repeated measurements)

	Period	Square sum of type III	Degree of freedom	Mean square	F-value	Significance probability
Time	2001 vs. 2003	329.341	1	329.341	7.714	0.007
	2003 vs. 2005	6.796	1	6.796	0.175	0.677
Error (time)	2001 vs. 2003	2732.397	64	42.694		
	2003 vs. 2005	2484.324	64	38.818		

feeling score in the period from 2003 to 2005. (See **Fig. 19** and **Table 5**.) Type -- victims who changed house 5 times as of 2001 had the lowest score for the life recovery feeling in the period from 2003 to 2005. This suggests that the number of times of changing house in the first five years after the earthquake could have a major influence on the long-term life recovery feeling in the period of the eighth to tenth year since the disaster.

(ii) "Participation in local activities": Victims of Type -- who answered in the 2001 survey that they sometimes, or often, participated in local events had a stronger life recovery feeling in the period from 2003 to 2005. Those who answered in 2001 that they seldom participated in local events had a weaker life recovery feeling in the period from 2003 to 2005. (See **Fig. 20** and **Table 6**.)

(iii) "Local town environment": The victims who answered in the 2001 survey that everyone lived an independent life with little communication with others had a weaker life recovery feeling in the period from 2003 to 2005. On the other hand, those who answered that people in town had frequent interactions with
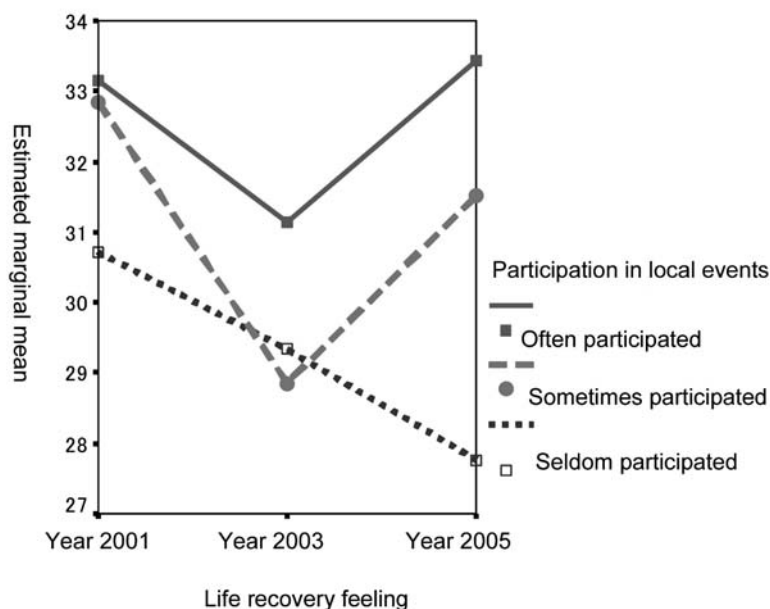
Fig. 20   Participation of Type -- victims in local events after the disaster, and change of average
scores of the life recovery feeling through the three surveys

Table 6. The influence of participating in local events on the life recovery feeling of Type -- victims (Between-class variation: one-way analysis of varia-
tion in the repeated measurements)

	Period	Square sum of type III	Degree of freedom	Mean square	F-value	Significance probability
Life recovery feeling	2001 vs. 2003	316.730	1	316.730	7.417	0.008
	2003 vs. 2005	66.626	1	66.626	1.867	0.177
Life recovery feeling * Participating in local events	2001 vs. 2003	84.726	2	42.363	0.992	0.377
	2003 vs. 2005	271.414	2	135.707	3.802	0.028
Error (life recovery feeling)	2001 vs. 2003	2647.671	62	42.704		
	2003 vs. 2005	2212.910	62	35.692		

each other and joined local activities had a stronger life recov-
ery feeling in the period from 2003 to 2005. (See **Fig. 21** and
Table 7.)

The above results suggest that the life recovery feeling of
Type -- victims was backed up by living in a fixed place with no
frequent change of house after the earthquake, having an environ-
ment that promoted participation in local events, or having local
interaction with other people as seen in the answer "people in town
interacted with each other" or "people greeted each other," not
just participating in local activities.

It is possible to make a rough prediction of the future long-
term change pattern of the victim's life recovery feeling, based on
the characteristics in the sixth year since the earthquake. To do
this, it is necessary to extract the victims of Type -- by using the 4
life recovery feeling patterns of the victims found in this study.
Stable residential status is particularly important for the victims of
Type --. Furthermore, not only measures for individual victims but
also measures taking advantage of the local community's potential

for life recovery would be effective for long-term support of the
victims.

6. FUTURE WORKS

In the present study, we clarified the mechanism of the life
recovery feeling of victims based on panel survey data. We con-
sider it necessary to track quantitatively and qualitatively victim's
life recovery process after disaster in other disaster-stricken areas.

The results of the panel survey of the victims that we used
provide valuable information not only for Japan but also for the
rest of the world. In addition to the present analysis, we should
make deeper analysis, for example by trying a descriptive expres-
sion method following the individual survey answers or by con-
structing a life recovery model based on a causal model covering
multiple surveys. Based on the analysis, we would like to prepare
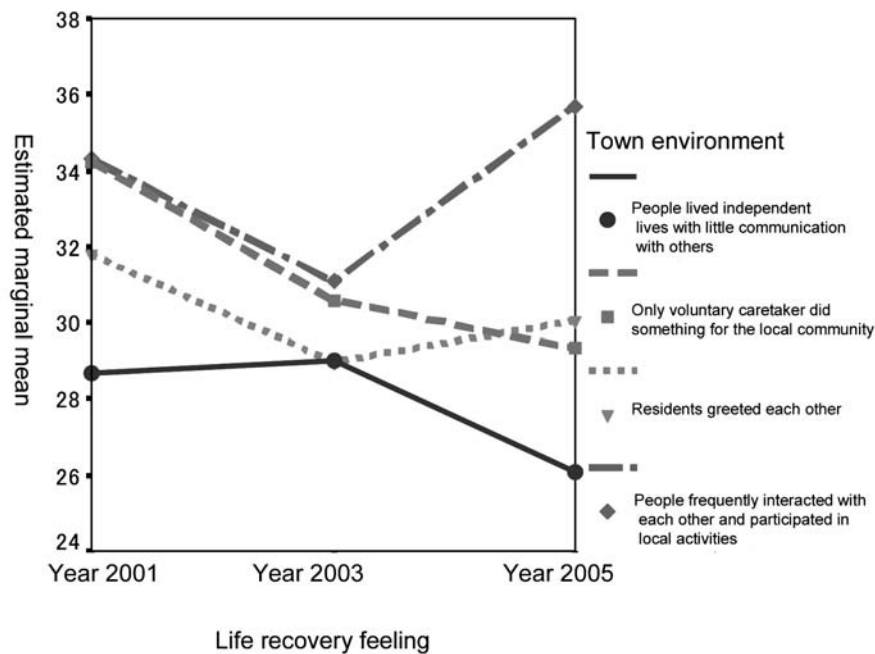information to support victims in other disaster areas.

Fig. 21 Attitude of Type -- victims toward the town environment after the disaster, and change of average scores of the life recovery feeling through the three surveys

Table 7. The influence of attitude toward the town environment on the life recovery feeling of Type -- victims (Between-class variation: one-way analysis of variation in the repeated measurements)

	Period	Square sum of type III	Degree of freedom	Mean square	F-value	Significance probability
Life recovery feeling	2001 vs. 2003	271.172	1	271.172	6.371	0.014
	2003 vs. 2005	7.361	1	7.361	0.212	0.647
Life recovery feeling * Town environment	2001 vs. 2003	136.166	3	45.389	1.066	0.370
	2003 vs. 2005	363.829	3	121.276	3.489	0.021
Error (life recovery feeling)	2001 vs. 2003	2596.231	61	42.561		
	2003 vs. 2005	2120.496	61	34.762		

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