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Huge tsunamis worsen blood glucose and blood pressure controls more than earthquake damage alone

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Running Head: Diabetes in tsunamis.

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Summary

1) Focus Article: The influences that the large earthquake and the tsunami exert on the blood glucose and the blood pressure controls are uncertain. Especially, the changes in the blood glucose and the blood pressure after the hospital and patient's home were collapsed by the huge tsunami, has not been reported in the past. Furthermore, whether the influences differ according to gender is also uncertain.

2) Key Messages: Huge tsunamis worsen blood glucose and blood pressure controls more than earthquake damage alone. The reason is that their treatments were not recovered as before the earthquake, because patient's medical information had lost completely. The maintenance of the medical information not lost in the earthquake and tsunami is important. The clinical records in the hospital and medicine information at home were swept away by the huge tsunami. Although the change in blood glucose was strongly influenced by tsunamis damage, the change in blood pressure was influenced rather by the gender.

3) Strengths and Limitations: We first clarified the influence that the large earthquake and the tsunami exerted on the blood glucose and the blood pressure controls. The size of our study was so small that it was difficult for us to analyze it. However, for the future, we do not hope for such an analysis to be done on more large-scale number of subjects.

Abstract

Objectives: On March 11, 2011, Japan was hit by a huge tsunami resulting from the Great East Japan Earthquake. It was unknown what influence the devastating tsunami would have on patients' glycemic and blood pressure (BP) controls.

Participants: We focused on 63 patients with diabetes mellitus who were affected by the earthquake. Parameters measured 4 months after the earthquake, including body mass index (BMI), glycosylated hemoglobin A1c (HbA1c) levels, systolic BP, and diastolic BP, were compared with those measured before the earthquake. Furthermore, the subjects were divided into two groups: those who were hit by the tsunami, the Tsunami (+) group (n = 28); and those who were not, the Tsunami (–) group (n = 35), and the groups' parameters and their changes were compared.

Results: HbA1c and both BP increased, while the numbers of most drugs taken decreased in both groups. Parameter changes were significantly greater in the Tsunami (+) group. All medical data stored at the hospital was lost in the tsunami. The Tsunami (+) patients also had their own records of treatment washed away, so it was difficult to replicate their pre-earthquake drug prescriptions afterwards. In comparison, the Tsunami (–) patients kept their treatment information; making it possible to resume the treatment they had been receiving before the earthquake. The BP rose only slightly in men, whereas it rose sharply in women, even though they had not been directly affected by the tsunami. BP rose markedly in both genders affected by the tsunami.

Conclusion: All medical information was lost in the tsunami, and glycemic and BP controls of the tsunami-affected patients worsened more than those of patients who had been affected by the earthquake alone. Women may be more sensitive to changes in the living environment that result from a major earthquake than are men.

Introduction

Rikuzentakata is a city located in the southeast of Iwate Prefecture in the Tohoku district of Japan [Supplementary figure (S) 1]. It has a population of 24,000, with about 34% aged 65 or older. The city consists of a small tract of lowland plains along a low shoreline, encircled by highlands (S1). Iwate Prefectural Rikuzentakata Hospital plays a central role in the medical service of the region. We have been visiting this hospital twice a month for the past two decades to treat diabetic outpatients. Although most patients had poor glycemic control and advanced organ disorders when we took over their treatment, long-term treatment resulted in well-controlled blood glucose and blood pressure (BP) levels in a large number of the patients.

On March 11, 2011, at 14:46, a huge magnitude 9.0 earthquake struck this area, its epicenter ca. 130 km to the east, off Oshika Peninsula in Miyagi Prefecture. About 20 minutes later, a massive tsunami more than 10 meters high hit the city[1)] (S2). Approximately 2,000 people died or disappeared. The town was demolished, and the hospital completely destroyed (S3). About 30,000 medical charts were washed away, and patient information stored on computer systems completely disappeared (S4). Numerous medical personnel rushed to the area from all over Japan to help treat survivors, and many lives were saved as a result.

In July 2011, about four months later, we finally resumed outpatient practice at a makeshift clinic (S5). The glycemic and BP controls of patients who had survived the ordeal had worsened due to traumatic changes in their living environments. There was, however, a marked difference in the level of deterioration of glycemic and BP controls between those who had lived in the plains area which had been struck by the tsunami, and those who had lived on higher ground, and who had thus escaped its full effects. We felt that identifying the reasons for this difference would be useful in establishing a medical setup that could, in future, prevent deterioration of glycemic and BP controls during times of disaster.

It appears that disasters of this scale can happen anywhere in the world. History demonstrates that such major earthquakes and tsunamis have occurred repeatedly.[2)] We therefore feel that analyzing our experiences on this occasion and reporting them is important for establishing a medical setup that can withstand such major disasters. This is what prompted us to publish this report.

Methods

Before the earthquake, approximately 120 patients were visiting Rikuzentakata Hospital for diabetic treatment. Only 63 patients returned to the clinic in July after the earthquake, and it is they who were analyzed in the present study. They were divided into 2 groups: the Tsunami (+) group, whose members lived in the lowland areas and who were hit by the tsunami (n = 28), and the Tsunami (–) group, whose members lived on higher ground and who were not hit by the tsunami (n = 35).

Body mass index (BMI), blood glucose levels (BG; not necessarily fasting), hemoglobin A1c [HbA1c (JDS)], systolic blood pressure (SBP), and diastolic blood pressure (DBP) were established as items for analysis, and were measured 4 months after the earthquake. All patients' medical data before the earthquake, which had been stored at the hospital, had been lost. However, we had collected and stored all patients' data in October 2010 for another study, [3] which was used as the pre-earthquake data on this occasion. The values for each parameter were compared thus: For the whole study group, each parameter after the earthquake was compared with its value before the earthquake. Similarly, parameters of the Tsunami (–) group before the earthquake were compared to those of the Tsunami (+) group before the earthquake, and parameters of the Tsunami (–) group after the earthquake were compared to those of the Tsunami (+) group after the earthquake. Changes also occurred in patients' use of drugs following the disaster. Such changes were analyzed in two categories of drugs, hypoglycemic and anti-hypertensive agents, by comparing the number of patients administered each drug. In addition, the absolute changes and percentage changes in their glycemic and BP controls, and those in their drug therapies, were analyzed.

Statistical analysis

Normally distributed values are presented as mean ± standard error of the mean (SEM). The obtained values of the parameters and of drug use were compared within the whole study group (before vs. after), and between the Tsunami (–) and the Tsunami (+) groups, using Student's *t*-test. The change from before the earthquake to after was calculated for each parameter. The change undergone by the Tsunami (–) group was compared with that undergone by the Tsunami (+) group by means of analysis of variance. Similarly, changes affecting male patients were compared to those affecting female patients, using the Mann-Whitney *U*-test. The χ^2 test was used to compare percentage changes in parameters and use of drugs between the Tsunami (–) and the Tsunami (+) groups, and a similar analysis of BP was performed, comparing males with females. Multiple regression analysis was used to identify whether tsunami exposure was an independent risk factor for the percentage increase of HbA1c, SBP, and DBP after the disaster. $P < 0.05$ was regarded as statistically significant.

Results

Table 1 shows means with standard errors of each parameter for all subjects before and after the earthquake. Only BMI decreased; BG, HbA1c, SBP, and DBP rose significantly.

There were also some changes in the use of drugs (represented by the number of patients administered the drug) after the disaster (table 2). The use of most anti-hyperglycemics decreased by 30–40%, except alpha-glucosidase inhibitors (AGIs) and glucagon-like polypeptide (GLP)-1 analogs. GLP-1 analogs were employed with only 2 patients—too small a number to analyze statistically. The number administered AGIs did not change after the earthquake. With anti-hypertensives, use of renin-angiotensin system inhibitors (RASIs) reduced most drastically, followed by other anti-hypertensives (beta blockers, alpha blockers, etc.), diuretics, and calcium channel blockers (CCBs), in order of decreasing reduction in use.

Within each group, changes in parameters were analyzed (table 3). In both groups, BMI decreased, while BG, HbA1c, SBP, and DBP significantly increased following the earthquake. The values of each parameter before and after the earthquake were compared between Tsunami (–) and Tsunami (+) groups. Although no differences were observed in the groups' pre-earthquake values, values of BG, HbA1c, SBP, and DBP afterwards were significantly higher in the Tsunami (+) group than in the Tsunami (–) group ($p4 < 0.05$). No differences in BMI were observed between the groups, even after the earthquake.

Changes and percentage changes in BG, HbA1c, SBP, and DBP were compared between Tsunami (–) and Tsunami (+) groups (S6). All percentage changes in these parameters were significantly higher in the Tsunami (+) group, so though all patients were affected by the same disaster, glycemic and BP controls deteriorated more in patients with tsunami exposure.

An overview of changes in usage of various drug treatments in both Tsunami (–) and

Tsunami (+) groups is given in table 4, which represents the number of patients taking each drug. Use of most drugs decreased in both groups following the earthquake. Administration of all anti-hyperglycemic drugs except AGIs decreased more in the Tsunami (+) than in the Tsunami (–) group. The decrease in the number of patients undergoing AGI treatment was 0% for both groups. After the earthquake, the use of dipeptidyl peptidase (DPP)-4 inhibitors and GLP-1 analog halted completely, and that of insulin decreased greatly in the Tsunami (+) group, yet their use did not decrease much or at all in the Tsunami (–) group. The use of all anti-hypertensive drugs decreased in both groups. In particular, the use of RASIs, other anti-hypertensives (e.g. sympatholytic agents), and diuretics decreased more in the Tsunami (+) than in the Tsunami (–) group. Additionally, the percentage decrease in the use of RASIs, diuretics, and others was significantly larger than of CCBs for both groups ($p<0.05$, χ^2-test, results not shown).

Multiple-regression analysis was performed using age, gender, and tsunami exposure, as well as percentage changes in BMI, BG, and HbA1c as independent variables, and percentage changes in HbA1c, SBP, and DBP as dependent variables (table 5). Our results show that tsunami exposure was an independent risk factor for increases in HbA1c. It was not an independent risk factor for BP changes, while gender was: women demonstrated greater increases in BP after the earthquake than men (S7), while tsunami exposure caused no difference in levels of BP elevation (table 5). So, women experienced BP rises even without tsunami exposure (S8, p3 = n.s.), and by contrast, though BP rose sharply in male members of the Tsunami (+) group, the rise was minimal among those of the Tsunami (–) group, (S8, $p4<0.05$).

Discussion

The patients' living environment drastically changed after the earthquake and tsunami. Most lived in evacuation centers during the first month after the incident, which perhaps prevented them from receiving sufficient supplies of food and drugs. From the second month on, the Tsunami (+) group was moved to makeshift housing units, while the Tsunami (–) group returned home. There were still food shortages, with rationing of certain items. Fresh foods like vegetables and fish were in particularly short supply, so patients mostly subsisted on preserved foods like sweets, pastries, canned products, cup noodles, and boil-in-the-bag foods. Two months after the earthquake, supplies of drugs returned to about pre-earthquake levels, but the food situation had still not completely recovered. Utility services—power, water, and gas—had not completely recovered even after three months, although they steadily approached pre-earthquake levels. Under these conditions, it was difficult to ensure that patients stuck to diet and exercise therapies. We believe this was one reason for the deterioration in glycemic and

BP controls.

Even under circumstances where loss of body weight appeared inevitable, and where in fact many patients did lose weight, there were some who managed to gain weight. Weight loss was probably caused by insufficient food intake in some patients, and by deteriorated glycemic control in others. Meanwhile, ingestion of preserved foods rich in sugar and fats may, for some other patients, have led to excessive intake of such nutrients, resulting in weight gain. Some patients developed hypoglycemia, as food was distributed through rationing, and they could no longer supplement a lack of calories by eating items like snack food between meals.

The chief reason for the worsening of glycemic and BP controls after the incident was probably the changes in the drugs administered. Had this survey been carried out immediately after the earthquake, such changes might have been attributable to insufficient supply of some types of drugs. However, when we conducted this survey, four months after the incident, drugs were already available in sufficient quantities. Despite this, fewer drugs were being administered to patients than they had received before the earthquake, impairing their patients' glycemic and BP controls. One possible reason for this is that, in conjunction with the changes in the living environment, patients might have been examined by and prescribed different, less effective drugs by a physician other than their attending doctor. Under conditions where meals are supplied at random intervals, drugs that are liable to cause hypoglycemia, like sulfonylurea derivatives, glinides, and insulin, are difficult to use.

In times of water shortage, drugs that carry risks of dehydration and acute renal failure (like RASIs and diuretics) or of heart failure (like pioglitazone) are contraindicated if a patient's physical status, including renal and cardiac function, is unknown. Sympathetic blockers are also difficult to use under such conditions. Additionally, in elderly patients with unclear renal function, such difficulty in prescribing applies to biguanides as well. The only biguanide derivative used at Rikuzentakata Hospital before the earthquake was buformin. Since its use is contraindicated in elderly patients and in those with reduced kidney function, 8 patients switched to metformin, which should be administered "with caution". Because of this, prescriptions of biguanides decreased after the disaster, and the number of patients who used metformin increased. Moreover, DPP-4 inhibitors and GLP-1 analog therapy were not used, probably because they had been released only recently in Japan, and their modes of use had not yet become fully known to non-specialists. It thus appeared that because of these circumstances, physicians frequently used AGIs, which are less liable to induce hypoglycemia and which cause minimal adverse events. Furthermore, during the first 3 months after the disaster, the medical setup was such that, instead of a single physician providing continuous treatment, various physicians from all over Japan (not necessarily diabetes or hypertension specialists) took turns examining patients, making it even more difficult to administer medications satisfactorily.

Though these conditions were the same for both groups, the level of deterioration in glycemic and BP controls differed markedly between the Tsunami (+) and the Tsunami (–) groups, most likely because the administration of drugs in the Tsunami (+) group had substantially decreased. The reasons for this may be as follows: Even after the earthquake, Tsunami (–) group patients had records of their treatment status on hand, like their diabetes databook for clinical co-operation and their medicine notebook, which lists drugs they are using. Moreover, immediately after the earthquake, they had leftover drugs prescribed immediately before (a day or 15 days before) the incident. So patients in the Tsunami (–) group were able to immediately resume their pre-earthquake treatment. In contrast, all such treatment information for patients in the Tsunami (+) group had been swept away by the tsunami. In addition, patient information previously stored in the hospital was also lost, making it impossible to resume the exact treatment they had been receiving before the disaster. Therefore patients in the Tsunami (+) group found themselves starting a completely new treatment regimen after the disaster. This appears to have drastically worsened their glycemic and BP controls. Despite belonging to the Tsunami (+) group, 2 patients had their medicine notebook with them, allowing them to immediately resume their pre-disaster treatment without causing aggravation of their glycemic or BP control.

No such phenomena were observed in nearby hospitals standing on higher ground, which did not suffer any tsunami damage. Needless to say, it is important to build hospitals that are not prone to tsunami damage. Even more crucial, is to have patients' medical information—especially the details of treatments—stored not only by patients and hospitals, but also at a different, possibly central, location. We believe that such centralized management is necessary, and may prevent patients' disease status from aggravating after a major disaster.

In men, BP rose strikingly only in the Tsunami (+) group. This appears to have been caused by the sharp decrease in the administration of anti-hypertensive drugs. In female patients, however, BP rose similarly in the Tsunami (–) and Tsunami (+) groups. This may imply that, while men are not very likely to develop BP rise as a result of an earthquake alone, women are likely to develop BP elevation as a result of only an earthquake, and that life after earthquakes may be more stress-inducing for women than for men (perhaps because of the challenges of ensuring a hygienic environment, toilets, bathing, supplies of female sanitary products, and problems with resuming work, etc.). It may be that women need more meticulous care than men after a major earthquake disaster, such as the present incident.

Tsunamis worsen patients' glycemic and BP controls for a long period after they strike, and this period may extend to several months. Clearly, storing and managing patients' treatment information is extremely important. However, even when treatment information was not destroyed or lost, some patients' symptoms worsened, because they had lost wives who had helped them with their diet therapy, or because the daughter who had cared for them had died. Needless to say, protecting people's lives, including family members', is the most important goal, and we need to focus on establishing disaster prevention setups that place the utmost priority on saving lives. We feel that hospitals, which become key bases for providing medical services in areas during times of disaster, should be built in disaster-proof locations (high ground in the case of this earthquake).

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Declaration of interest

We declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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Author contribution statement

Author Contributions

Susumu Ogawa researched data, wrote manuscript, contributed to discussion.

Mikihito Ishiki is a director of Rikuzentakata Hospital. He offered the data and the information necessary for this investigation.

Kazuhiro Nako, Masashi Okamura, Miho Senda and Takuya Sakamoto researched data and contributed discussion,

Sadayoshi Ito contributed to discussion, reviewed/edited manuscript.

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Table 1. Parameters (body mass index, glycemic control, and blood pressure control) of all study subjects before and after the earthquake.

n		63						
Age	(years)	68.1 ± 1.4						
M/F		29 / 34						
		before			after			p
BMI	(kg/m^2)	25.8	±	0.5	25.5	±	0.5	<0.01
BG	(mg/dL)	109.4	±	3.9	134.3	±	7.2	<0.01
HbA1c (JDS)	(%)	5.9	±	0.2	6.5	±	0.2	<0.01
SBP	(mmHg)	121.0	±	1.2	136.1	±	2.9	<0.01
DBP	(mmHg)	67.2	±	1.0	74.1	±	1.6	<0.01

mean ± SEM

M: male, F: female, BMI: body mass index,

BG: blood glucose concentration, HbA1c (JDS): glycosylated hemoglobin A1c,

SBP: systolic blood pressure, DBP: diastolic blood pressure.

Table 2. The use of diabetic treatment drugs and anti-hypertensive drugs before and after the earthquake, and their percentage changes.

	before	after	% change (%)
hypoglycemic agents			
sulfonylureas	26	16	-38.5
glinides	27	18	-33.3
α-glucosidase inhibitors	29	29	0
biguanides	44	28	-36.4
pioglitazone	28	18	-35.7
DPP-4 inhibitors	22	15	-31.8
insulin therapies	26	17	-34.6
GLP-1 analogs	2	0	-100.0
anti-hypertensive agents			
RAS inhibitors	36	7	-80.6
CCBs	32	22	-31.3
diuretics	23	7	-69.6
others	15	3	-80.0

DPP-4: dipeptidyl peptidase-4, GLP-1: glucagon-like polypeptide-1, RAS: renin angiotensin system, CCB: calcium channel blocker.

Table 3. The comparison of each parameter in the Tsunami (–) and Tsunami (+) groups.

Tsunami		(-)			(+)				
		before	after	p1	before	after	p2	p3	p4
n		35			28				
Age	(years)	67.8 ± 2.0			68.4 ± 2.1			n.s.	
M/F		18 / 17			11 / 17				
BMI	(kg/m^2)	26.0 ± 0.7	25.7 ± 4.3	<0.05	25.6 ± 0.8	25.1 ± 0.8	<0.05	n.s.	n.s.
BG	(mg/dL)	112.0 ± 5.0	121.7 ± 7.1	<0.05	106.3 ± 6.1	150.8 ± 13.0	<0.01	n.s.	<0.05
HbA1c	(%)	5.9 ± 0.1	6.1 ± 0.1	<0.05	5.9 ± 0.1	7.0 ± 0.3	<0.01	n.s.	<0.01

SBP	(mmHg)	122.1 ± 1.8	133.8 ± 4.2	<0.05	119.6 ± 1.3	139.0 ± 3.7	<0.01	n.s.	<0.01
DBP	(mmHg)	68.1 ± 1.6	73.8 ± 2.1	<0.01	66.1 ± 1.1	74.6 ± 2.2	<0.01	n.s.	<0.05

means ± SEM

M: male, F: female, BMI: body mass index, BG: blood glucose concentration

HbA1c (JDS): glycosylated hemoglobin A1c, SBP: systolic blood pressure, DBP: diastolic blood pressure

p1: before vs. after in Tsunami (-) group, p2: before vs. after in Tsunami (+) group,

p3: Tsunami (-) group vs. Tsunami (+) group before the earthquake,

p4: Tsunami (-) group vs. Tsunami (+) group after the earthquake.

Table 4. Changes in the use of various drug treatment in the Tsunami (–) and Tsunami (+) groups.

Tsunami	(-)			(+)			p
	before	after	% change 1 (%)	before	after	% change 2(%)	
hypoglycemic agents							
sulfonylureas	15	11	-26.7	11	5	-54.6	<0.01
glinides	18	16	-11.1	9	2	-77.8	<0.01
α-glucosidase inhibitors	17	17	0	12	12	0	n.s.
biguanides	27	25	-7.4	17	3	-82.4	<0.01
pioglitazone	19	17	-10.5	9	1	-88.9	<0.01
DPP-4 inhibitors	16	15	-6.3	6	0	-100.0	<0.01
insulin therapies	13	13	0.0	13	4	-69.2	<0.01
GLP-1 analogs	0	0	0.0	2	0	-100.0	-
anti-hypertensive agents							
RAS inhibitors	20	7	-65.0	7	0	-100.0	<0.01
CCBs	17	15	-11.8	15	7	-53.3	<0.01
diuretics	13	6	-53.9	10	1	-90.0	<0.01
[illegible]	7	3	-57.1	8	0	-100.0	<0.01

p : % change 1 vs. % change 2, DPP-4: dipeptidyl peptidase-4, GLP-1: glucagon-like polypeptide-1,

RAS: renin angiotensin system, CCB: calcium channel blocker.

Table 5. Results of multiple regression analyses, using the percentage changes in HbA1c, SBP, and DBP as dependent variables, and some parameters as independent variables.

dependent variables	% change of HbA1c		% change of SBP		% change of DBP	
independent variables	β	p	β	p	β	p
Age	-0.08	0.60	0.05	0.79	-0.07	0.69
Gender	0.84	0.81	-6.94	0.08	-9.21	0.03
% change in BMI	0.22	0.75	0.60	0.44	0.49	0.56
% change in BG	0.04	0.18	0.04	0.25	0.05	0.12
% change in HbA1c	-	-	0.15	0.31	0.23	0.15
Exposure to Tsunami	11.37	0.00	2.55	0.57	-2.29	0.64

P < 0.05: significant, BMI: body mass index, HbA1c: glycosyated hemoglobin A1c, SBP: systolic blood pressure, DBP: diastolic blood pressure.

Supplementary figure 1 (S1)

Rikuzentakata is a regional city with a population of 24,000, located in the southeast of Iwate Prefecture in the Tohoku region of Japan. Its exact location is 141 degrees 38 minutes east, 39 degrees 1 minute north. Its location is extremely close to the epicenter of the Great East Japan Earthquake (magnitude 9.0), which occurred at 2:46 p.m. on March 11, 2011. The city is comprised of a relatively small low-lying area that extends over a part of the low shoreline, and of high ground that encircles the flat area (see aerial photo). The flat area was completely destroyed by the massive tsunami, but the high ground escaped damage.

Supplementary figure 2 (S2)

About twenty minutes after the earthquake occurred, a massive tsunami, more than 10 meters in height, swept into this area. These photos were shot from a ward on the 4th floor of the Takata Hospital. A gigantic wave came from the eastern side of the seacoast and instantly engulfed the hospital building. Eventually, the hospital was flooded nearly to the roof. Because of this tsunami, hospital staff and inpatients were compelled to evacuate to the rooftop. Some, however, were swallowed by the tsunami, and died.

Supplementary figure 3 (S3)

Photo A was shot from the hospital rooftop, showing the city of Rikuzentakata after the waves had ebbed away. The tsunami flooded almost the entire lowland area, where it caused catastrophic damage. Ordinary houses that had once stood in the low-lying area were washed away without a trace. Only the smashed shells of a few reinforced steel-framed houses and office buildings were left behind. It can be seen from this photo that the tsunami destroyed the low-lying areas, but left the higher ground intact.

Photo B is an aerial shot of Rikuzentakata City after the onset of the tsunami. It can be seen that most of the houses in the plains area simply disappeared. However, houses in upland areas surrounding the plain suffered no damage. Shown in the upper and middle part of the photograph is the location of the Yonezaki Community Center, where a temporary emergency clinic was installed after the disaster. The location where the Rikuzentakata Hospital once stood can also be seen.

Photo C shows the interior of the hospital after the tsunami. The interior suffered catastrophic damage, bringing hospital operations to a complete halt. It can be seen that all hospital functions, including the power supply system, were destroyed.

A

B

C

Supplementary figure 4 (S4)

The photo shows the area near the hospital reception desk after the tsunami. Patients' medical information (charts), which had been stored at the back of the reception desk, along with the computers that had stored this information, were all lost. Subsequently, even if a patient came in person to the hospital, it was impossible to confirm which chronic disease the patient had, what treatment he or she had been receiving, or what condition he or she was in. This became a major obstacle to resuming the treatment of patients who had been affected by the tsunami.

Supplementary figure 5 (S5)

This photo shows the temporary clinic that was opened shortly after the earthquake. It was set up inside the Yonezaki Community Center, which miraculously escaped tsunami damage. The layout is extremely simple, with foldable chairs and tables only. Outpatient treatment was provided amid a series of large-scale aftershocks. (A) Since the building was originally constructed as a community center, it had some shortcomings as a medical facility. The examination rooms were dark and cramped. (B) Nevertheless, many patients came to this makeshift clinic.

A

B

Supplementary figure 6 (S6)

This figure compares the changes which occurred in the levels of blood glucose (BG), glycated hemoglobin A1c (HbA1c), systolic blood pressure (SBP), and diastolic blood pressure (DBP), as measured before and after the earthquake. The changes are expressed as absolute values ("change") and percentage values ("% change"), and the values for the Tsunami (–) and Tsunami (+) groups are compared. All parameters demonstrated significantly greater changes (including % changes) in the Tsunami (+) group than in the Tsunami (–) group. It is clear that in the aftermath of the earthquake, these 4 parameters rose far more dramatically in the Tsunami (+) group than in the Tsunami (–) group. The comparisons of the changes and of the percentage changes in each parameter were carried out by ANOVA and by a χ^2 test, respectively.

Supplementary figure 6 (S6)

Tsunami		(-)			(+)			p
Change in BG	(mg/dL)	9.1	±	5.7	44.6	±	14.1	< 0.01
% change in BG	(%)	9.3	±	5.9	51.9	±	16.7	< 0.01
Change in HbA1c	(%)	0.3	±	0.1	1.1	±	0.2	< 0.01
% change in HbA1c	(%)	4.6	±	1.8	17.3	±	3.2	< 0.01
Change in SBP	(mmHg)	11.7	±	3.7	19.5	±	2.8	< 0.01
% change in SBP	(%)	9.6	±	3.0	15.9	±	2.3	< 0.01
Change in DBP	(mmHg)	5.6	±	1.9	8.5	±	1.6	< 0.01
% change in DBP	(%)	9.1	±	3.4	12.7	±	2.5	< 0.01

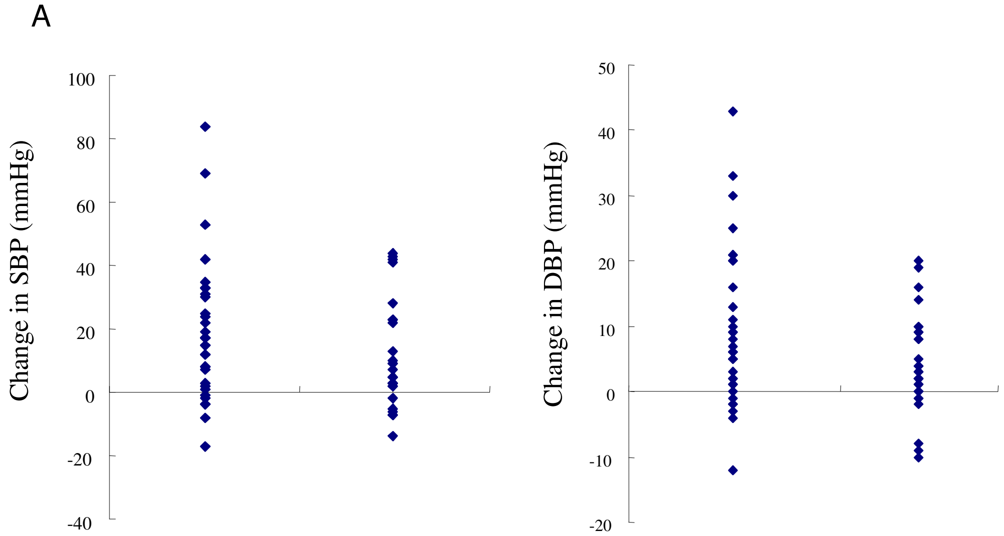
BG; blood glucose, SBP; systolic blood pressure, DBP; diastolic blood pressure.

mean ± SEM

Supplementary figure 7 (S7)

This figure compares, by gender, the absolute changes (A) and percentage changes (% change) (B) in systolic blood pressure (SBP) and diastolic blood pressure (DBP) that occurred due to the earthquake. Women demonstrated major and significant absolute changes as well as % changes in both SBP and DBP. It is clear that blood pressure in women rose far more dramatically after the earthquake than in men.

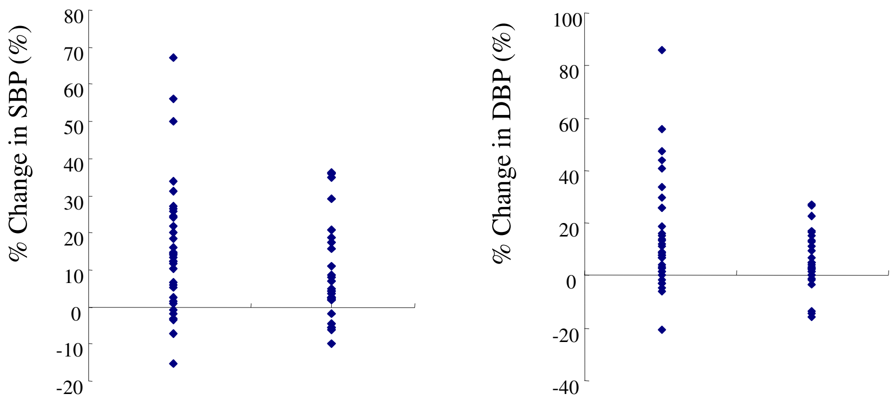
Supplementary figure 7 (S7)



gender		Female	Male	p	Female	Male	p
mean ± SEM		19.1 ± 3.6	10.6 ± 2.9	< 0.05	9.2 ± 2.0	4.2 ± 1.4	< 0.05
	Total	34	29		34	29	
number	Tsunami (+)	17	11		17	11	
	Tsunami (-)	17	18		17	18	

Supplementary figure 7 (S7)

B



gender		Female	Male	p	Female	Male	p
mean ± SEM		15.8 ± 3.0	8.4 ± 2.3	< 0.05	15.0 ± 3.5	5.7 ± 2.0	< 0.01
number	Total	34	29		34	29	
	Tsunami (+)	17	11		17	11	
	Tsunami (-)	17	18		17	18	

Supplementary figure 8 (S8)

This table compares the percent change ("% change") in blood pressure (BP) observed in each gender according to the presence or absence of tsunami exposure. Overall, those who had suffered tsunami exposure demonstrated a marked rise in their BP. Among those without exposure to the tsunami, the BP rose only slightly in men, whereas it rose sharply in women, even though they had not been directly affected by the tsunami. BP rose markedly in both genders affected by the tsunami. Whether or not they had sustained tsunami exposure did not affect the degree of BP elevation in women, which implies that BP rises sharply in women simply as a result of a major earthquake, irrespective of whether they suffered any exposure to the tsunami. It may be that women are more sensitive to changes in the living environment that result from a major earthquake than are men.

Supplementary Figure 8 (S8)

Tsunami	-	+	
numbers	35	28	p0
% change in SBP	9.6 ± 3.0	15.9 ± 2.3	<0.05
% change in DBP	5.6 ± 1.9	8.5 ± 1.6	<0.05

	Female	Male	p1	Female	Male	p2	p3	p4
numbers	17	18		17	11			
% change in SBP	16.6 ± 5.5	2.9 ± 1.6	<0.05	15.0 ± 2.4	17.3 ± 4.4	n.s.	n.s.	<0.05
% change in DBP	15.9 ± 6.2	2.7 ± 1.8	<0.05	14.1 ± 3.3	10.4 ± 3.8	n.s.	n.s.	<0.05

mean ± SEM

SBP: systolic blood pressure, DBP: diastolic blood pressure,

p0: Tsunami (-) group vs Tsunami (+) group, p1: female vs male in Tsunami (-) group, p2: female vs male in Tsunami (+) group,

p3: Tsunami(-) group vs Tsunami (+) group in female, p4: Tsunami(-) group vs Tsunami (+) group in male,