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Deep-vein thrombosis detection rates and consideration of the living environment in a tsunami disaster area during the disaster reconstruction phase: A cross-sectional study

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Abstract

Introduction: *Tsunami victims of the Great East Japan Earthquake were screened for deep-vein thrombosis (DVT) in order to compare the DVT incidence rates between temporary and non-temporary housing resident groups.*

Material and methods: *Lower extremity venous ultrasonography was performed on 290 subjects (64 men and 226 women; mean age = 71.9 ± 7.9 years) at 44 months after the disaster. All subjects completed questionnaires to gather information about their background factors which included the Kessler Psychological Distress Scale: K6.*

Results: *The DVT detection rate was 10.7% in the temporary group. In the non-temporary group, it was 11.3% among the subjects who previously lived in temporary housing. For the subjects who were living in their own homes,*

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it was 9.2%. Psychological distress levels measured by K6 were significantly higher in the temporary housing group than in the non-temporary housing group. The multivariate analysis showed that the background factor associated with DVT risk was SV (soleal vein) dilatation in all subjects as well as in the non-temporary housing group, while hypertension and use of sleeping pills were found to be the factors in the temporary housing group.
Conclusions: *DVT detection rates were similar between the temporary and non-temporary housing groups, and were higher than that in the Japanese general population. The psychological distress level of the tsunami victims measured by K6 was also higher in the temporary housing group than in the non-temporary housing group. It is necessary to establish a long-term and awareness-raising disaster victim support system.*

Key words: Great East Japan Earthquake, tsunami disaster area, temporary housing, disaster-related diseases, psychological distress survey

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Introduction

After a major disaster, the risk of cardiovascular disease, infection and psychological disorders increases among survivors under stressful conditions [1]. Deep vein thrombosis (DVT), one of the disaster-related diseases, has been attracting public attention since the Mid Niigata Prefecture Earthquake in 2004 [2]. An increased risk of developing DVT was reported among evacuees in emergency shelters and temporary housing in disaster areas [2–6]. Post-disaster DVT is assumed to occur at a high rate due to poor living conditions in shelters and temporary housing, under which evacuees dehydrate because they try to refrain from water intake to reduce their frequency of urination, face low levels of physical activity and sleep in vehicles [2–6].

In Ishinomaki City, Miyagi Prefecture, another area affected by a tsunami after the Great East Japan Earthquake, an increased risk of developing DVT over a long period of time was reported among residents in temporary housing and houses in the affected area even after their living environment was improved [4]. Our study was conducted in Watari-gun, Miyagi Prefecture (Watari-town and Yamamoto-town), an area which was also severely affected by the tsunami. In our study area, the temporary housing was gradually removed as reconstruction progressed from the third year after the disaster, and the living conditions for survivors were improved. DVT screening was performed for the purpose of prevention and to raise awareness among disaster survivors. Temporary housing residents are more likely to develop DVT because of their low activity levels. This study reports on the comparison of DVT detection rates between temporary housing residents (temporary housing group) and non-temporary housing residents (non-temporary housing group) and also on the identified risk factors.

Material and methods

Disaster situation in our study area

Watari-gun, Miyagi Prefecture (Watari-town and Yamamoto-town) is located approximately 40 km south of Sendai City and is an industrial area focusing on agriculture and fishing with a population of approximately 50,000. In the Great East Japan Earthquake, there were 885 people who died or were missing, 13,000 people were forced to evacuate from their homes, and 7,075 houses were destroyed or partially destroyed. In September 2011, the number of evacuees living in temporary housing reached 6,050. These temporary housing complexes were however mostly removed as reconstruction progressed.

Study subjects

A total of 290 subjects who were living in temporary housing and houses in neighboring areas in Watari-gun, Miyagi Prefecture (64 men, 226 women; mean age = = 71.9 ± 7.9 years) participated in our screening activity. The subjects were divided into two groups: 149 in the temporary group (33 men, 116 women; mean age = 73.4 ± 8.4 years) and 141 in the non-temporary group (31 men, 110 women; mean age = 70.3 ± ± 7.0 years). Of the 141 subjects in the non-temporary housing group, 44 were those who previously lived in temporary housing (9 men, 35 women; mean age = = 70.8 ± 9.4 years), and 97 were those who continued living in their own homes (22 men, 75 women; mean age = 70.0 ± 5.6 years). There were 179 subjects who previously underwent DVT screenings (including screenings conducted by other organizations). The screening was performed at 44 months after the disaster for a total of 2 days (November 1 and 2, 2014). Two subjects in the temporary housing group and four in the non-temporary housing group were excluded because of inadequacies in the Kessler Psychological Distress Scale (K6) questionnaire, resulting in the temporary housing group having 147 and the non-temporary housing group having 137. Our targeted number of participants was approximately 300.

Setting and examination team

DVT screening was undertaken at meeting places located in temporary housing, healthcare centers and public halls in Yamamoto-town, Watari-gun, Miyagi Prefecture. The medical examination team was organized mainly by the University of Fukui School of Medical Sciences with cooperation from volunteer healthcare providers (doctors, nurses, laboratory medical technologists, etc.) and medical students.

Examination items

Our DVT screening activity was performed in temporary housing in cooperation with the local authority of Watari-town and Yamamoto-town. Posters to raise awareness about DVT prevention were displayed one month prior to the screening. Participation in the screening was on a voluntary basis. All subjects provided written informed consent, and the examination was conducted in the following order: a questionnaire (age, sex, lifestyle, K6, underlying disease, life after a disaster), blood pressure measurement, lower-extremity venous ultrasonography and explanation of the result. The underlying diseases (dyslipidemia, diabetes mellitus, heart disease, hypertension) of the subjects were reported based on their answers to the self-report questionnaire. When subjects answered in the questionnaire that the time spent walking was reduced in comparison with before the disaster, they were classified as having reduced walking hours. The ultrasonography was performed by several medical technologists, each with more than five years of experience [5, 6]. To improve uniformity, the evaluation criteria were discussed prior to the screening [5, 6]. Screening was undertaken using portable ultrasound machines (LOGIQe, GE Healthcare with a 3.3–10.0 MHz linear probe; Noblus, Hitachi Medical Corporation with a 5–18 MHz linear probe; CX50, Philips Japan, Ltd., with a 3–12 MHz linear probe; Viamo, Canon Medical Systems Corporation with a 6.2–11.0 MHz linear probe; NanoMaxx, SonoSite Inc., with a 6–13 MHz linear probe). Ultrasound examinations were performed from the calf to the popliteal veins in the sitting position [5, 6]. Only screening of the calf to the popliteal veins was conducted due to the large number of participants as well as the limitations in our screening setting and time [5, 6]. The presence of thrombus was confirmed using a combination of the color Doppler and the compression technique, where there was a lack of compressibility [5–8]. Thrombi were classified as organized or fresh [6, 9–11]. Inner diameters (short-axis) of the soleal vein (SV) were measured in the sitting position with the lower extremity muscles relaxed, and maximum diameter was used in our analysis. When measuring the diameters, the probe was placed so as not to put pressure on the SV and measurements were not made on the venous valves. The maximum diameter of the soleal vein (SV) was examined, and a diameter ≥ 8 mm was defined as dilatation [6, 12]. Subjects who were found to be DVT-positive received a patient referral document and were encouraged to visit their local medical institutions. K6 was also used to measure the psychological distress levels of the subjects. K6 consisted of six items measuring depression and anxiety over the past month on a five-point scale [13]. The Japanese version of the K6 has also been developed and the reliability and validity have been confirmed [14]. Because the levels of psychological distress caused by the tsunami disaster were assumed to be high in our study area, subjects who scored more than 13 points were classified as having a psychological disorder [15].

Statistical analysis

Age, systolic blood pressure, diastolic blood pressure, K6 and SV diameter are reported as means ± standard deviations, and categorical variables are reported as frequency and percentage (%). R commander version 1.28 was used for the statistical analysis. Mann-Whitney U test and the χ^2 test (including Yates' continuity correction) were used for comparisons between the two groups. To identify risk factors for DVT, multivariate logistic regression analysis (stepwise method) was performed. In all comparative tests, a p-value of < 0.05 was considered statistically significant.

Results

DVT was diagnosed in 30 of the 290 subjects screened (10.3%), of whom 13 were fresh thrombi (4.4%) and 17 were organized thrombi (5.8%).

Comparison of demographic characteristics in all subjects with or without DVT is shown in Tables 1, 2 and Figure 1.

Univariate analysis showed that SV dilatation (43.3% vs 19.2%; $p < 0.01$) and a previous history of DVT screening (83.3% vs 59.2%; $p < 0.05$) were significantly higher in the DVT-positive group than in the negative group. Multivariate analysis showed that SV dilatation was the background factor associated with DVT risk in all subjects (odds ratio 3.21; 95% confidence interval 1.460–7.040; $p = 0.0035$).

Comparison of demographic characteristics of subjects with or without DVT in the temporary housing group is shown in Tables 1, 2, and Figure 1.

Table 1. Demographic characteristics and ultrasonographic findings (univariate analysis)

	all 290 cases			Temporary housing group 149 cases			Non-temporary housing group 141 cases		
	DVT Present n = 30	DVT Absent n = 260	p-value	DVT Present n = 16	DVT Absent n = 133	p-value	DVT Present n = 14	DVT Absent n = 127	p-value
Age(years)	72.0 ± 8.3	71.8 ± 7.8	0.905	74.1 ± 8.6	73.3 ± 8.4	0.6787	69.6 ± 7.6	70.3 ± 6.9	0.712
Gender (male/female)	6/24	58/202	0.955	2/14	31/102	0.506	4/10	27/100	0.774
Blood pressure									
SBP (mm Hg)	141.6 ± 16.6	137.8 ± 19.5	0.308	143.3 ± 14.9	137.0 ± 20.1	0.1186	139.6 ± 18.8	138.5 ± 18.8	0.567
DBP (mm Hg)	82.2 ± 14.7	80.3 ± 13.5	0.484	83.7 ± 15.2	79.2 ± 14.4	0.07426	80.5 ± 14.5	81.6 ± 12.4	0.8685
Lifestyle									
Exercises n (%)	19 (63.3)	179 (68.8)	0.684	8 (50)	86 (64.7)	0.382	11 (78.6)	93 (73.2)	0.911
Smoker n (%)	2 (6.7)	20 (7.7)	1	1 (6.2)	15 (11.3)	0.852	1 (7.1)	5 (3.9)	1
Use of sleeping pills n (%)	14 (46.7)	81 (31.2)	0.131	10 (62.5)	46 (34.6)	0.057	4 (28.6)	35 (27.6)	1.000
Underlying disease									
DL n (%)	19 (63.3)	142 (54.6)	0.474	10 (62.5)	65 (48.9)	0.444	9 (64.3)	77 (60.6)	1
DM n (%)	5 (16.7)	36 (13.8)	0.886	4 (25)	21 (15.8)	0.564	1 (7.1)	15 (11.8)	0.937
Heart disease n (%)	10 (33.3)	71 (27.3)	0.63	7 (43.89	34 (25.6)	0.214	3 (21.4)	37 (29.1)	0.768
HT n (%)	20 (66.7)	138 (53.1)	0.222	13 (81.2)	66 (49.6)	0.033	7 (50)	72 (56.7)	0.845
Insomnia n (%)	1 (43.3)	107 (41.2)	0.973	8 (50)	59 (44.4)	0.871	5 (35.7)	48 (37.8)	1
Life after a disaster									
Reduced urination (Acute phase of the disaster) n (%)	9 (30.0)	76 (29.2)	1	5 (31.2)	40 (30.1)	1.000	4 (28.6)	36 (28.3)	1.000
Sleeping in a vehicle (Acute phase of the disaster) n (%)	6 (20.0)	53 (20.4)	1	2 (12.5)	25 (18.8)	0.784	4 (28.6)	28 (22.0)	0.828
Lower limb symptoms (Acute phase of the disaster) n (%)	11 (36.7)	105 (40.4)	0.844	6 (37.5)	61 (45.9)	0.712	5 (35.7)	44 (34.6)	1
Reduction of walking hours n (%)	16 (53.3)	129 (49.6)	0.847	13 (81.2)	83 (62.4)	0.226	3 (21.4)	46 (36.2)	0.419
Temporary housing resident n (%)	16 (53.3)	133 (51.2)	0.973						
Previous history of DVT screening n (%)	25 (83.3)	154 (59.2)	0.0176	14 (87.5)	113 (85.0)	1	11 (78.6)	41 (32.3)	0.00184
Ultrasonographic findings									
Maximum diameter of the soleal vein (mm)	7.5 ± 1.7	6.6 ± 1.74	0.0157	7.7 ± 1.6	6.5 ± 1.5	0.00689	7.2 ± 1.8	6.8 ± 1.9	0.458
Soleal veindilatation (≥ 8 mm)	13 (43.3)	50 (19.2)	0.0051	6 (37.5)	23 (17.3)	0.111	7 (50)	27 (21.3)	0.040

Mean ± standard deviation. Nominal variables are shown as frequency(%); ns: non–significant difference
SBP: systolic blood pressure; DBP: diastolic blood pressure; DL: dyslipidemia; DM: diabetes mellitus; HT: hypertension; DVT: deep vein thrombosis
continuous variables: Mann–Whitney U test (between each pair of two groups); nominal variables: χ^2 test(between each pair of two groups)

Table 2. Risk factor analysis of deep vein thrombosis (multivariate analysis)

	All 290 cases			Temporary housing group 149 cases			Non-temporary housing group 141 cases		
	Odds ratio	95% CI	p-value	Odds ratio	95% CI	p-value	Odds ratio	95% CI	p-value
Age (years)	0.994	0.943–1.05	0.816	1.01	0.93–1.09	0.853	0.986	0.895–1.09	0.772
Gender (male)	0.758	0.294–2.100	0.628	0.37	0.071–1.9	0.237	1.34	0.363–4.97	0.659
Lifestyle									
Exercises n (%)	0.937	0.386–2.27	0.88	0.713	0.213–2.39	0.58	1.45	0.335–6.3	0.618
Smoker n (%)	0.876	0.177–4.34	0.854	0.725	0.0071–7.32	0.758	1.82	0.164–20.2	0.626
Use of sleeping pills n (%)	1.96	0.901–4.270	0.872	3.270	1.09–9.81	0.034	1.310	0.337–5.08	0.697
Underlying disease									
DL n (%)	1.29	0.557–2.84	0.58	1.180	0.36–3.85	0.788	1.300	0.392–5.05	0.642
DM n (%)	1.16	0.393–3.43	0.786	1.670	0.45–6.19	0.443	0.992	0.095–10.3	0.995
Heart disease n (%)	1.18	0.507–2.74	0.704	1.700	0.534–5.38	0.37	0.572	0.145–2.26	0.426
HT n (%)	1.8	0.795–4.060	0.159	4.550	1.22–17.0	0.024	0.782	0.243–2.52	0.680
Reduction of walking hours n (%)	1.01	0.441–2.3	0.989	2.64	0.663–10.5	0.169	0.438	0.113–1.7	0.232
Temporary housing resident n (%)	1.13	0.509–2.490	0.77						
Soleal vein dilatation (≥ 8 mm)	3.21	1.46–7.040	0.00359	2.850	0.868–9.33	0.084	3.700	1.2–11.5	0.023

multiple logistic regression analysis (risk factors associated with deep vein thrombosis)
SBP: systolic blood pressure; DBP: diastolic blood pressure; DL: dyslipidemia; DM: diabetes mellitus; HT: Hypertension; DVT: deep vein thrombosis

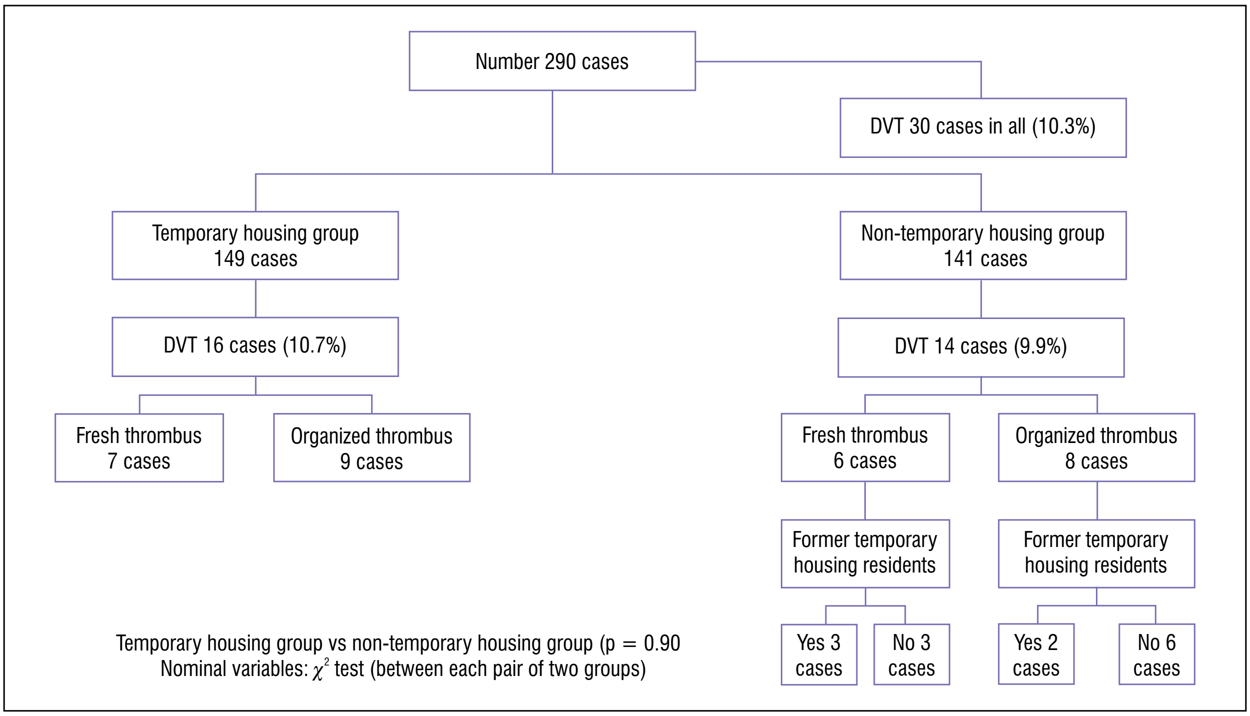

Figure 1. Flow diagram of subject selection

Univariate analysis showed that the rate of subjects with hypertension (81.2% vs 49.6%; $p < 0.05$) was significantly higher in the DVT-positive group than in the negative group. Multivariate analysis showed that hypertension (odds ratio 4.4; 95% confidence interval 1.200–16.100; $p = 0.025$) and use of sleeping pills (odds ratio 3.27; 95% confidence interval 1.090–9.810; $p = 0.034$) were the risk factors for DVT in the temporary housing group.

Comparison of demographic characteristics of subjects with or without DVT in the non-temporary housing group is shown in Tables 1, 2, and Figure 1.

Univariate analysis showed that SV dilatation (50.0% vs 21.3%; $p < 0.05$) and previous history of DVT screening (78.6% vs 32.3%; $p < 0.01$) were significantly higher in the DVT-positive group than in the negative group. Multivariate analysis showed that SV dilatation (odds ratio 3.7; 95% confidence interval 1.200–11.500; $p = 0.023$) was the background factor associated with DVT risk in the non-temporary housing group.

Comparison of DVT detection rates and background factors between temporary and non-temporary housing groups is shown in Table 3 and Figure 1.

The DVT detection rates in the temporary and non-temporary housing groups were 10.7% (16 of 149) and 9.9% (14 of 141), respectively, Therefore, no significant difference was observed ($p = 0.90$). Of the 16 DVT-positive subjects in the temporary housing group, seven had fresh thrombi and nine had organized thrombi. The DVT detection rate for the former temporary housing residents in the non-temporary housing group was 11.3% (5 of 44). Of the five, three had fresh thrombi and two had organized thrombi. The DVT detection rate among those who continued living in their homes in the non-temporary group was 9.2% (9 of 97). Of the nine, three had fresh thrombi and six had organized thrombi. In the comparison of background factors, age (73.4 ± 8.4 years vs 70.3 ± 7.0 years; $p < 0.005$), reduction of walking hours (64.4% vs 34.8%; $p < 0.0001$) and previous history of DVT screening (85.2% vs 36.9%; $p < 0.0001$) were significantly higher in the temporary housing group than in the non-temporary housing group.

Comparison of psychological distress levels of subjects between temporary and non-temporary housing groups is shown in Table 4.

Univariate analysis showed that age (73.3 ± 8.4 years vs 70.3 ± 7.0 years; $p < 0.005$), K6 (11.2 ± 5.9 vs 9.7 ± 4.9; $p < 0.05$) and psychological disorder (38.1% vs 22.6%; $p < 0.01$) were significantly higher in the temporary housing group than in the non-temporary housing group.

Table 3. Comparison of temporary housing and non-temporary housing group (characteristics of individuals studies)

	Temporary housing n = 149	Non-temporary housing n = 141	p-value
Age (years)	73.4 ± 8.4	70.3 ± 7.0	0.00276
Gender (male/female)	33/116	31/110	1
Blood pressure			
SBP (mm Hg)	137.7 ± 19.7	138.7 ± 18.7	0.6483
DBP (mm Hg)	79.7 ± 14.5	81.4 ± 12.6	0.1243
Lifestyle			
Exercises n (%)	94 (63.1)	104 (73.8)	0.0679
Smoker n (%)	16 (10.7)	6 (4.3)	0.0626
Use of sleeping pills n (%)	56 (37.6)	39 (27.7)	0.094
Underlying disease			
DL n (%)	75 (50.3)	86 (61)	0.0878
DM n (%)	25 (16.8)	16 (11.3)	0.247
Heart disease n (%)	41 (27.5)	40 (28.4)	0.976
HT n (%)	79 (53.0)	79 (56)	0.692
Insomnia n (%)	67 (45)	53 (37.6)	0.871
Life after a disaster			
Reduced urination (Acute phase of the disaster) n (%)	45 (30.2)	40 (28.4)	0.831
Sleeping in a vehicle (Acute phase of the disaster) n (%)	27 (18.1)	32 (22.7)	0.412
Lower limb symptoms (Acute phase of the disaster) n (%)	67 (45)	49 (34.8)	0.098
Reduction of walking hours n (%)	96 (64.4)	49 (34.8)	< 0.0001
Previous history of DVT screening n (%)	127 (85.2)	52 (36.9)	< 0.0001
Ultrasonographic findings			
DVT n (%)	16 (10.7)	14 (9.9)	0.973
Maximum diameter of the soleal vein (mm)	6.6 ± 1.5	6.9 ± 1.9	0.185
Soleal vein dilatation (≥ 8 mm)	29 (19.5)	34 (24.1)	0.414

Mean ± standard deviation. Nominal variables are shown as frequency (%).
SBP: systolic blood pressure; DBP: diastolic blood pressure; DL: dyslipidemia; DM: diabetes mellitus; HT: hypertension; DVT: deep vein thrombosis
Continuous variables: Mann-Whitney U test (between each pair of two groups); nominal variables: χ^2 test (between each pair of two groups)

Table 4. Comparison of temporary housing and non-temporary housing group (Kessler Psychological Distress Scale K6)

	Temporary housing group n = 147	Non-temporary housing group n = 137	p-value
Age (years)	73.3 ± 8.4	70.1 ± 6.9	0.0028
Gender (male/female)	33/114	31/106	1
K6	11.2 ± 5.9	9.7 ± 4.9	0.0264
K6 (≥ 13)	56 (38.1)	31 (22.6)	0.007

Mean ± standard deviation. Nominal variables are shown as frequency (%)
Continuous variables: Mann-Whitney U test (between each pair of two groups) nominal variables χ^2 test (between each pair of two groups)

Discussion

DVT detection rates and risk factors in all subjects

A high incidence of DVT detected by the lower extremity venous ultrasonography was also reported in a study conducted among residents in the affected areas after the Mid Niigata Prefecture Earthquake in 2004, and the incidence rate remained higher compared with that in the non-disaster area in Japan even eight years after the disaster [16]. The high detection rate (13.5%) was also reported in the temporary housing resident population in the case of Iwate Prefecture even four years after the Great East Japan Earthquake. Therefore, the risk of DVT is assumed to increase after a major disaster regardless of the type of evacuation, and is likely to remain high for a long period of time [5]. In this study, the overall DVT detection rate at 44 months after the disaster was 10.3%, which was still much higher than that of the general Japanese population (1.8–2.3%) [4]. Our screening program has also identified that SV dilatation is a background factor associated with DVT risk in all subjects. SV dilatation is a known risk factor for DVT in post-disaster settings. The SV was found to be the most important as the initial site of DVT caused by blood flow stasis [17]. The incidence of DVT associated with SV dilatation has also been reported in several studies [12, 18, 19]. Many cases of idiopathic DVT were observed among Japanese people who had a SV diameter ≥ 7 mm. In the disaster affected areas after the Kumamoto Earthquake, DVT was diagnosed more in survivors (staying in disaster shelters) who had an SV diameter ≥ 8 mm than those with a smaller diameter. In the survivor population of the Great East Japan Earthquake, SV dilatation (≥ 9 mm) in the DVT-positive group was reported to be significantly higher than that in the DVT-negative group (≥ 9 mm) [6, 12, 18]. In the patients who underwent arthroplasty, SV dilation (≥ 10 mm) was reported to be an independent positive predictor of DVT [19]. SV dilatation has not only been reported as a risk factor for DVT, but also as a factor for sustained DVT [20]. SV dilatation contributes to thrombus formation and results in the development of DVT. This may suggest that people with SV dilatation are more likely to suffer from sustained DVT. When physicians treat patients with DVT, they should note that SV dilation is a typical factor in ultrasound imaging that indicates a history of DVT.

In the disaster area, it has been shown that disuse syndrome can diminish calf muscle pump functionality, which causes venous congestion, and people are more likely to develop DVT. In the case of tsunami victims in Ishinomaki City, low levels of physical activity due to their inconvenient lifestyle were observed and this might have contributed to the development of disuse syndrome regardless of living in temporary housing or in their own homes [4]. To avoid having low levels of physical activity, exercise classes were therefore carried out mainly at temporary housing locations. These classes were effective in improving their sense of well-being, but it did not have a substantial impact on the disaster victims [21]. Our study population might have had exercise habits, but we assume that the reduced levels of physical activity were unable to be prevented. In our walking-hour survey, half of the disaster victims stated that their walking time per day was reduced compared to what it was before the earthquake. SV dilatation caused by reduced levels of physical activity after the disaster may have contributed to the development of DVT.

Our high detection rate of DVT may be due to the fact that this study was conducted in a disaster-affected area and included disaster victims with underlying diseases (hypertension, diabetes mellitus and dyslipidemia). Metabolic syndrome (MetS), the clustering of hypertension, hyperlipidemia, diabetes mellitus, and obesity, is a known factor for increasing the risk of venous thromboembolism (VTE) [22]. In addition, an increased risk of recurrent VTE following the accumulation of MetS components, including hypertension, diabetes mellitus, dyslipidemia and obesity, was reported [23]. The VTE recurrence rate was 14% in patients with one component, followed by 21% with two components, 30% with three components, and 37% with all four components [23]. The higher the number of MetS components, the higher the risk of VTE.

Disaster-related DVT was not found to disappear even after several years in many people who developed it immediately after the disaster [5, 16]. The reason for this may be because disaster victims with organized thrombi are more likely to suffer from recurrent DVT over a long period of time [6, 16]. SV dilatation has been shown to be a risk factor for DVT in our study, but it was also reported to be a risk factor for sustained DVT. In addition to this, our study has included subjects who developed DVT immediately after the disaster as well as those who had underlying diseases. This may have contributed the high DVT detection rates in our study.

Addressing self-selection and non-respondent biases is necessary in disaster area studies. In this study, there were many subjects who were concerned about disaster-related diseases, which might have introduced self-selection bias, and thus the actual prevalence of DVT might have been lower than that shown in our study. On the other hand, in order to avoid non-respondent bias, it is particularly important to take measures to encourage all survivors to participate in social activities, including screening activities, in the disaster affected areas.

Comparison of background factors between temporary and non-temporary groups

In the comparison of background factors including those related to living conditions during the disaster reconstruction phase, age, reduction of walking hours and psychological disorders were found to be significantly higher in the temporary housing group than in the non-temporary housing group. In the psychological distress level survey using K6, the prevalence of psychological disorders in both the temporary housing group

(38.1%) and non-temporary housing group (22.6%) were remarkably higher than in the general Japanese population (2.3%) [24]. A post-disaster survey in Miyagi Prefecture (18 years and older) reported that the prevalence of psychological disorders was 8.6% in disaster public housing and 7.5% in temporary housing [25]. The prevalence was higher in our study subjects both in temporary and non-temporary housing groups. The rate in another survey (35.9%), which was conducted one year after the disaster among residents (40 years and older) in Iwanuma City, Miyagi Prefecture, shows a percentage similar to that of the temporary housing group rate in our study [26]. There may be a gap between the regions within the same prefecture. Because the majority of our subjects belong to the elderly population, the increase in the number of psychological disorders may have been a change specific to the elderly. In the disaster reconstruction phase, stress reactions are likely to cause solitary deaths and social withdrawal among elderly people, and these changes are more common among women [27–29]. However, more than 70% of the subjects in our study were women in both groups, and this suggests that no difference due to gender may have been observed in the detection rates. Although the risk factors for DVT differ between temporary and non-temporary housing groups, there is no significant difference in the DVT detection rates, which were high in both groups even three years after the disaster. Although there are some differences in terms of support for survivors and their living conditions between the temporary and non-temporary housing groups, it can be assumed that the onset and sustaining of DVT is a health problem related to the lifestyle of individual survivors. In contrast, the risk factors for DVT differ between the temporary and non-temporary groups. Because a previous study reported that risk factors for DVT could change over time after the disaster, the difference in environmental improvement levels might have led to the variation of risk factors [4, 5, 16, 30]. The risk factors for DVT in this study differ between the temporary and non-temporary groups depending on the support system and their living conditions, which might have contributed to the high incidence of DVT in both groups.

Risk factors for DVT in the temporary housing group

In our study, the risk factors for DVT in the temporary housing group were hypertension and the use of sleeping pills. The association between hypertension and DVT was reported in a study conducted six years after the Mid Niigata Prefecture Earthquake [31]. After a major disaster, the risk of cardiovascular disease, infection and psychological disorders increases among survivors under stressful conditions, and hypertension was the most common incidence [1, 32]. The temporary housing group can be referred to as a high-stress population as they scored 19.1 ± 9.1 in the K6. The use of drugs, such as antipsychotics, and alcohol that depress the central nervous system and cause muscle relaxation of the lower extremity may also contribute to the development of DVT [33, 34]. The longer the evacuation period lasts, the more people complain of mental health problems and insomnia, and they want to take sleeping pills. The use of sleeping pills was reported as one of the risk factors for DVT in a previous study conducted after the Kumamoto Earthquake in 2016 [35]. Because some types of sleeping pills have muscle relaxation effects [36], special attention needs to be paid to prevent the development of DVT. Given these, risk factors for DVT (hypertension and the use of sleeping pills) can be applied to disaster-affected areas in common regardless of the type of disaster. For example, an earthquake directly above its epicenter, tsunami disaster or others.

This study has several limitations. First, this was a cross-sectional study and causality was therefore not determined. Second, a detailed assessment for the stage when our subjects were staying in the disaster shelters was not made. Third, a detailed assessment regarding previously reported common risk factors for DVT was not made. Fourth, because many subjects in the temporary housing group had a history of DVT screening, the awareness of DVT was possibly high in this population. Fifth, it was impossible to target all disaster victims living in temporary housing. Sixth, because medical history and lifestyle were judged using a self-report questionnaire, considerations based on the actual influence were not made. Seventh, those with underlying diseases were also included in our study. Eighth, elderly women tended to participate in community health and social welfare programs more than elderly men. Therefore, less elderly men participated in our study. Future studies that take these eight limitations into consideration are therefore necessary.

Conclusions

DVT detection rates were similar between the temporary and non-temporary housing groups, and were higher than that in the general Japanese population. The Psychological distress levels of the tsunami victims measured by K6 were higher in the temporary housing group than in the non-temporary housing group. It is necessary to establish a long-term and awareness-raising disaster victim support system to prevent disaster-related diseases.

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Conflict of interest

None.

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