問題である．被災した高校で，サポートに直接につなげるという目的があったため，記名式の調査としたが，その結果，厳密にはコントロールサンプルとして比較検討できる先行研究が存在しなかった．QIDS-Jに関しては，同じ調査票を用いた高校生への無記名の調査があったが，SASとCD-RISC10についてはコントロールといえるものがなく，カットオフなどを用いて全体的な傾向を捉えるしかなかった．今後，対照地域を定め同じフォーマットで調査を行うことで，より厳密な災害の影響を評価しえると思われる．

第二に，単年度の調査で，どの程度被災地の高校生の心理状態を正確に反映できるかという問題である．この調査を行った7月下旬は，高校2年生ならば進路調査を，高校3年生ならば進路の確定を行い始めているところであり，それが今回の調査に大きく反映している可能性がある．単発の調査ではその時々のエピソードが反映される可能性があるため，何度か繰り返し調査を加えながら，被災地の高校生の心理状態を把握することが望ましい．よって，本調査は3年間継続で行う予定である．

おわりに
——高校生への心理支援の展望——

現在調査結果を各高校にフィードバックし，抑うつや不安，PTSRの強い生徒へのサポートを展開している．震災から1年半たってなお，偶然目にした津波映像で情緒不安定になって保健室に運ばれる生徒や，学校において連鎖的な過呼吸発作を起こす生徒が多数存在し，震災以前はみられなかったような忙しさで学校精神保健の対応がなされ，精神科医療につながるケースも出てきている．今回の調査によって，震災が子どもに与える影響は，年少児だけでなく高校生の年代にも顕著に認められることがわかり，高校生の年代は現実の困難さ(人生の進路選択)に直面するため，学年が上がり不利な条件が重なるほどに，2次的に抑うつや不安が高まる傾向が認められた．それらに対するサポートに必要性が示唆された．今後この経過を前向きに追跡しながら，コントロール群の設定も含めて継続的に調査を行っていく予定である．

なお，本論文に関連して開示すべき利益相反はない．

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文　献

1) Abe, R., Nushida, H., Ueno, Y., et al.: Influence on the suicide rate two years after a devastating disaster: A report from the 1995 Great Hanshin-Awaji Earthquake. Psychiatry Clin Neurosci, 63(2); 247-250, 2009

2) 赤澤正人：若年者における自殺関連行動—自殺企図と死生観との関連性—．死の臨床，35(1); 90-94, 2012

3) 飛鳥井　望：不安障害　外傷後ストレス障害(PTSD)．臨床精神医学増刊号; 171-177, 1999

4) Campbell-Sills, L., Stein, M.B.: Psychometric analysis and refinement of the Connor-Davidson Resilience Scale(CD-RISC): Validation of a 10-Item Measure of Resilience. J Traum Stress, 20(6); 1019-1028, 2007

5) Chou, F.H., Wu, H.C., Chou, P., et al.: Epidemiologic psychiatric studies on post-disaster impact among Chi-Chi earthquake survivors in Yu-chi, Taiwan. Psychiatry Clin Neurosci, 61(4); 370-378, 2007

6) 遠藤太郎，塩入俊樹，鳥谷部真一ほか：新潟県中越地震が子どもの行動に与えた影響．精神医学，49(8); 837-843, 2007

7) 藤澤大介，中川敦夫，田島美幸ほか：日本語版自己記入式簡易抑うつ尺度(日本語版QIDS-SR)の開発．ストレス科学，25; 43-52, 2010

8) 藤井千太，二見友紀子，福井　愛ほか：阪神淡路大震災10年後の高度被災地区精神科診療所初診患者における被災の心理的影響．心的トラウマ研究，5; 71-78, 2009

9) 井上貴雄，宮島真紀，傳田健三ほか：小・中・高校生における抑うつ症状，躁症状および自閉傾向．児童精神経誌，54(5); 571-587, 2013

10) 加藤　寛：日本における災害精神医学の進展．精神医学，48(3); 231-239, 2006

11) 勝又陽太郎，松本俊彦，木谷雅彦ほか：インターネット上の自殺関連情報にアクセスした経験をもつ若年者の実態とその特徴．日社精医誌，18; 186-198, 2009

12) 香月毅史，鈴木英子，叶谷由佳ほか：特殊災害時における一般市民のPTSD罹患率に影響を与える要因．精神医学，54(8)；837-845，2012

13) 黒川淳一，井上眞人，井奈波良一ほか：高校生女子バスケットボール部員におけるメンタルヘルス(その1)—精神健康度に影響をおよぼす要因—．臨床精神医学，31(11)；1341-1350，2002

14) Lai, C. H.: Major Depressive Disorder Gender Differences in Symptoms, Life Quality, and Sexual Function. J Clin Psychopharmacol, 31(1)；39-44, 2011

15) 松岡洋夫：東日本大震災と精神保健医療福祉の中長期的計画—宮城県の場合—．精神経誌，114(3)；218-222，2012

16) 中島聡美，金　吉晴，小西聖子ほか：日本版コナー・デビッドソン回復力尺度の信頼性と妥当性の検討．平成21年度厚生労働科学研究費補助金 こころの健康科学研究事業「大規模災害や犯罪被害等による精神科疾患の実態把握と介入手法の開発に関する研究」分担研究報告書．2010

17) 岡村　仁，山崎正数，瀬良裕邦ほか：自己評価式不安尺度 SAS)の信頼性と妥当性の検討．精神科診断学，2(1)；113-119，1991

18) 大野高志，船越俊一，角藤芳久ほか：名取EIプロジェクト—宮城県立精神医療センターを中心とした早期介入プロジェクトについて—．精神経誌，115(2)；147-153，2013

19) 大澤茉梨恵，井上貴雄，傳田健三ほか：一般市民における抑うつ症状—自殺予防対策としてのうつスクリーニング事業から—．臨床精神医学，43(2)；249-257，2014

20) Scali, J., Gandubert, C., Ritchie, K., et al.: Measuring resilience in adult women using the 10-Item Connor-Davidson Resilience Scale(CD-RISC). Role of trauma exposure and anxiety disorders. PLoS One, 7(6)；e39879, 2012

21) 塩山晃彦，植本雅治，新福尚隆ほか：阪神淡路大震災が小中学生に及ぼした心理的影響(第二報：震災後2年目までの推移)．精神経誌，102(5)；481-497，2000

22) 田中三栄子，伊熊克己，秋野禎見ほか：ライフスタイルと健康に関する研究　高校生と大学生の睡眠，食生活，飲酒，運動習慣，健康観，自覚症状についての比較．スポーツ整復療法学研究，4(3)；161-173，2003

23) 植本雅治，塩山晃彦，小出佳代子ほか：阪神淡路大震災が小中学生に及ぼした心理的影響 第一報)．精神経誌，102(5)；459-480，2000

24) Usami, M., Iwadate, Y., Kodaira, M., et al.: Relationships between traumatic symptoms and environmental damage conditions among children 8 months after the 2011 Japan Earthquake and Tsunami. PLoS One, 7(11)；e50721, 2012

Factors Associated with the Psychological Impact of the Great East Japan Earthquake on High School Students 1 Year and 4 Months after the Disaster

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The purpose of this study was to investigate factors associated with the psychological impact of the Great East Japan Earthquake on high school students 1 year and 4 months after the disaster, and clarify support needs of the students. In the outreach program for students of three high schools in coastal areas of southern Miyagi Prefecture, Japan, 1,973 students were surveyed after obtaining informed consent for participation. Questionnaires included: the Quick Inventory of Depressive Symptomatology(QIDS-J), Self-rating Anxiety Scale(SAS), Impact of Event Scale-revised(IES-R), and Connor-Davidson Resilience Scale(CD-RISC10). All scores were compared using SPSS 20.0 J between school grades, locations of the schools, and extent of damage due to the Great East Japan Earthquake. Our analysis showed a significant positive correlation between school grades and the level of anxiety. PTSR scores, but not anxiety nor depressive scores, of students whose lives have suffered extensive damage were significantly higher than those of students who have not. Students of high schools which have suffered extensive damage and use temporary buildings showed significantly higher levels of depression and anxiety, and significantly lower resilience, compared to students of high schools which were not damaged. Although previous findings demonstrated that younger children have a higher risk of being influenced by disasters, symptoms related to PTSR and depression were found frequently in the high school students as well. Among the high school students, our analysis showed a positive correlation between the level of anxiety and school grades, probably because the disaster has affected an influential and pivotal point in their lives.

<Authors abstract>

<**Keywords**: Great East Japan Earthquake, high school students, PTSR, depression, anxiety>

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Leg Extension Power Is a Pre-Disaster Modifiable Risk Factor for Post-Traumatic Stress Disorder among Survivors of the Great East Japan Earthquake: A Retrospective Cohort Study

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Abstract

Background: Post-traumatic stress disorder (PTSD) is a common psychological problem following natural disasters. Although pre-disaster risk factors are important for early detection and proactive support, the examination of such has been limited to sociodemographic factors, which were largely unaffected by the disasters. We examined the association between pre-disaster physical functioning and lifestyle and PTSD symptoms five months after the earthquake in the Great East Japan Earthquake survivors who were participating in a pre-existing cohort study.

Methods: We designed a retrospective cohort study of a cooperative association in Sendai from August 2010 to August 2011. In 2010, lifestyle, physical condition, and sociodemographic factors were examined by self-reported questionnaires completed by 522 employees of this organization. We also measured the leg extension power of all the participants. PTSD symptoms were evaluated by the Japanese version of the Impact of Event Scale-Revised (IES-R-J) following the earthquake of 2011.

Results: In multivariate linear regression analysis, leg extension power ($\beta = -0.128$, $P = 0.025$), daily drinking ($\beta = 0.203$, $P = 0.006$), and depressive symptoms ($\beta = 0.139$, $P = 0.008$) were associated with total score of the IES-R-J among men. Moreover, for the IES-R-J subscale, leg extension power was also negatively associated with Intrusion ($\beta = -0.114$, $P = 0.045$) and Hyperarousal ($\beta = -0.163$, $P = 0.004$) after adjusting for all other significant variables. For women, hypertension ($\beta = 0.226$, $P = 0.032$) and depressive symptoms ($\beta = 0.205$, $P = 0.046$) were associated with the total score of the IES-R-J.

Conclusions: Leg extension power is a potentially modifiable pre-disaster risk factor among men for attenuating the severity of PTSD symptoms associated with great disasters such as the Great East Japan Earthquake among men.

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Introduction

On 11 March 2011, the Great East Japan Earthquake and Tsunami devastated the northeastern coast of Japan and left approximately 18,500 dead or missing. Further, about 200,000 survivors were forced to live in uncomfortable environments after they were evacuated [1,2]. The survivors were not only damaged both physically and mentally, but they were also forced to change their lifestyle habits during the peri-disaster period. Post-traumatic stress disorder (PTSD) is a common psychological problem following natural disasters, including earthquakes and tsunamis [3]. PTSD is associated with suicide attempts and high health care costs [4,5]; therefore, it is important to identify the risk factors for PTSD to enable earlier detection and provide more urgently needed support for those suffering from PTSD after natural disasters.

Previous studies have identified three categories of PTSD risk factors: pre-disaster (e.g., gender, education level, psychiatric history); peri-disaster (e.g., degree of exposure to the event); and post-disaster (e.g., lack of social support) [6,7]. Compared with peri- and post-disaster risk factors, pre-disaster risk factors are more important from the standpoint of preparing for unexpected large-scale disasters in countries that are prone to them, such as Japan [8]. Such advanced planning is necessary to prevent the declining mental health that naturally follows as a result of these

disasters. As mentioned previously, the existing literature on pre-disaster risk factors has been limited to either sociodemographic factors or psychiatric history, neither of which can be changed easily to ensure a more positive outcome for disaster survivors. Detection of modifiable risk factors, such as physical function and lifestyle-related factors, may not only enable the early discovery of a PTSD prone individual, but it also may make it possible to develop PTSD resistance in those who would be prone to it.

Under non-disaster ordinary conditions, low physical function is associated with increased risk of depression [9], depression morbidity [10] or the persistence of depressive and anxiety disorders [11]. These findings suggest the possibility that even under disaster conditions, lower physical function could be associated with poor mental health. Tsai et al. showed that participants with posttraumatic stress symptoms (PTSS) had a lower score in both the physical component summary and the physical functioning subscales of the Medical Outcomes Study Short Form-36 (MOS SF-36) at both six months and three years after the Chi-Chi earthquake [12]. This result indicates that poorer mental health after the earthquake had a significant negative influence on future physical functioning, though physical function level before the earthquake was not evaluated in the previous study. Accordingly, it remains possible that participants with PTSS could have already had a lower physical function level before the earthquake, suggesting the possibility that physical function could be a modifiable risk factor for PTSD after disasters.

In addition, it is well-established that healthy behavior intervention contributes to mental health as well as physical health [13]. Under disaster conditions, there are two opposite possibilities for the associations between lifestyles and PTSD. One is that people with healthy lifestyle could preserve their mental health even under a stressful situation, and the other is that, rather, they could have higher stress level from disrupting their lifestyle, leading to more stressful refuge life. Given that previous studies reported that an individual's lifestyle after a disaster has also been associated with PTSD among war veterans [14–16], lifestyle before disasters also could be associated with PTSD after disasters or life-disrupting, stress-inducing situations. However, the associations of pre-disaster factors with PTSD cannot be examined, unless these factors had been examined in an organized survey before disasters.

We conducted the Oroshisho longitudinal study, which comprised a cohort of adult employees working at the Sendai Oroshisho Center in Sendai, the area close to the epicenter of the earthquake, from August 2008 to August 2011 [17–20]. This study aimed to investigate the risk factors for lifestyle-related illness, including metabolic syndrome. In this study, we designed a one-year retrospective cohort study to examine the association between pre-disaster lifestyle, physical functioning, and PTSD symptoms, which was evaluated by a self-report questionnaire administered to survivors of the Great East Japan Earthquake post-disaster.

Methods

Study Participants

The participants were employees of the Sendai Oroshisho Center, a group of over 120 small and medium enterprises in Sendai, Miyagi prefecture, Japan (Figure 1). The Sendai Oroshisho Center is located in Oroshi-machi in Eastern Sendai, where the tsunami approached within 2–3 km distance, and many buildings were damaged or destroyed by the earthquake. Most participants live in the Miyagi prefecture, where the disaster affected normal life for more than one month [21].

The sample selection process was as follows (Figure 2). In 2010, 1189 participants (926 men and 263 women) received annual health examinations for lifestyle-related illnesses, including anthropometric measurements, hematological examinations, and additional assessments of lifestyle and physical function. Of these, 1185 (922 men and 263 women) participated in our survey. Those who did not undergo health examinations in 2011 (n = 248) were excluded. Moreover, we excluded 22 participants who had not answered the Impact of Event Scale-Revised (IES-R) and 380 participants who had not been measured for leg extension power. We also excluded 13 participants due to incomplete data. Final analyses included 522 participants (399 men and 123 women).

Ethics Statement

The protocol of this study was approved by the Institutional Review Board of the Tohoku University Graduate School of Medicine. After a complete description of the study was provided to the subjects, written informed consent was obtained from each of them.

PTSD Symptoms

The Impact of Event Scale-Revised (IES-R) [22], a short, easily administered self-report questionnaire, was used to evaluate probable PTSD in August 2011. The IES-R uses 22 items and a four-point Likert-type scale to assess the three most common symptoms of PTSD: intrusion, avoidance, and hyperarousal. It is the most widely used measure internationally in all forms of disaster area research, and the both the validity and reliability of the Japanese version of the IES-R (IES-R-J) has been confirmed [23]. The IES-R-J was useful in identifying survivors with PTSD symptoms as a clinical concern (full and partial PTSD) after various kinds of traumatic events [23]. In this study, the total scale and subscale (Intrusion, Avoidance, and Hyperarousal) scores were calculated. Moreover, we used the cut-off of 24/25 proposed by Asukai [23], as the cut-off was applied to survivors of a disaster, where individuals with a total IES-R-J score greater than or equal to 25 were regarded as having "probable PTSD." The internal reliability for this study was 0.93.

Physical Function Factor

In order to evaluate physical function, maximal bilateral leg extension power (W) was determined by using an isotonic apparatus (Anaeropress 3500; Combi Co., Tokyo, Japan). After warming up, the participants reclined on the seat and placed both feet on the footplate at a knee angle of 90°. The load of the footplate was set to the subject's weight. Subjects pressed their feet horizontally as intensely as possible until their legs extended fully. Five trials were performed at 15-s intervals, and the highest value was chosen for inclusion in the analyses. The reliability and validity of the leg extension power measurement were evaluated and described in details elsewhere [24].

Lifestyle-related Factors

Information on smoking status (never, former, or current smoker), alcohol-drinking status (never, 1–6 day(s)/week, or 7 days/week), and sleep duration (6–8 hours, <6, or >8 hours) was obtained from a questionnaire survey. Levels of daily physical activity (PA) were estimated using the International Physical Activity Questionnaire (Japanese version) [25], and the responses were divided into three categories (<1, 1–22, or ≥23 metabolic equivalent of tasks (METs) × hours/week). More than 23 METs × hours/week is the quantity of PA and exercise recommended for the promotion of health by the Ministry of Health, Labour and

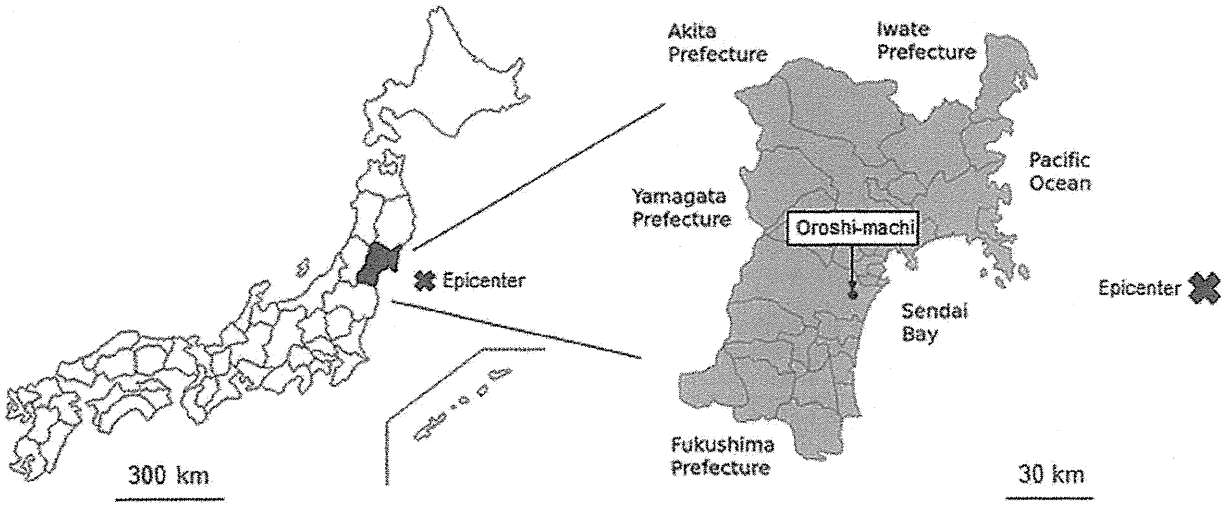

Figure 1. Location of the epicenter of the Great East Japan Earthquake and Oroshi-machi. (a) The epicenter of the East Japan Earthquake (cross) was under the Pacific Ocean about 150 km east of the Miyagi Prefecture. (b) The Sendai Oroshisho Center is located in Oroshi-machi in Eastern Sendai, where the tsunami approached within 2–3 km distance.
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Welfare of Japan [26]. The frequency of breakfast consumption was assessed with the question "How many times do you eat breakfast a week?" and the responses were categorized into two groups: those who ate breakfast≥4 times/week and those who ate breakfast less than four times per week [27]. Frequency of daily toothbrushing in the preceding month was assessed by a self-reported questionnaire, and participants were categorized into two groups: those who brushed ≥3 times/day and those who brushed less than three times/day.

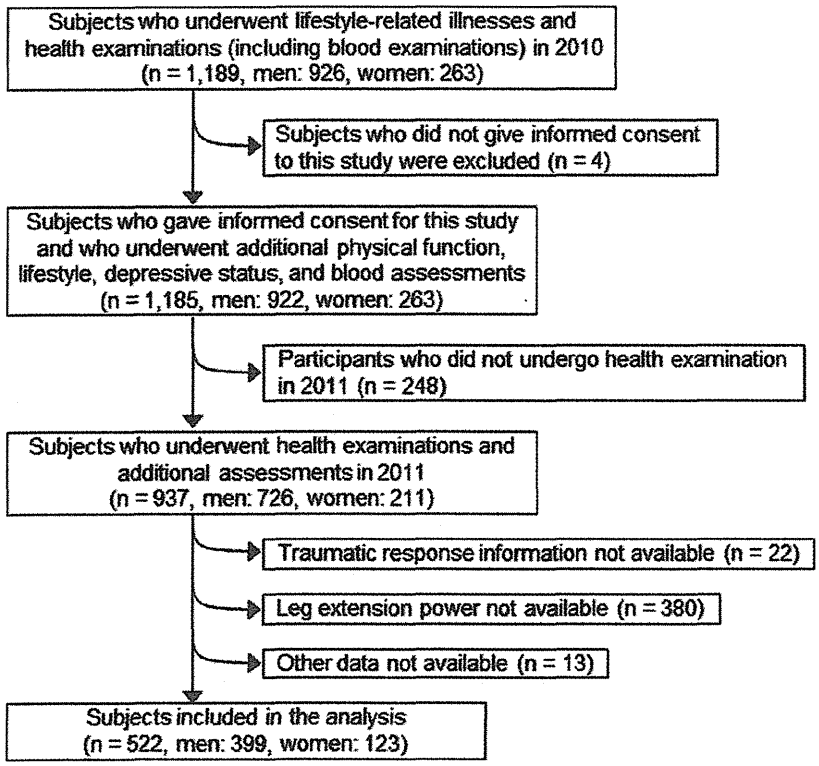

Figure 2. Flow chart of the sample selection process.
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Physical Condition Factors

Blood pressure (BP) was measured twice in each participant's left upper arm using an automatic device (YAMASU605P; Kenzmedico Co. Ltd., Saitama, Japan) after a five-minute resting period in a seated position. The mean values of systolic and diastolic BP were used as the BP values, respectively. Blood samples were drawn from the antecubital vein, with minimal tourniquet use, while the subjects were still seated. The specimens were collected in siliconized vacuum glass tubes containing sodium fluoride for fasting blood glucose and no additives for lipid analyses. Fasting blood glucose concentration was measured by enzymatic methods (Eerotec, Tokyo, Japan). The triglyceride, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol concentrations were measured by enzymatic methods using the appropriate kits (Sekisui Medical, Tokyo, Japan).

Histories of diabetes, hypertension, and dyslipidemia, and current treatments for each were evaluated on the basis of yes or no responses. Participants were considered to have diabetes if they had hyperglycemia (a fasting blood glucose level ≥126 mg/dL) or were receiving treatment for diabetes. Hypertension was identified if a measured systolic blood pressure was ≥140 mmHg or a measured diastolic blood pressure ≥90 mmHg, or if the participant reported being treated for hypertension. Dyslipidemia was identified if a measured blood triglyceride level was ≥ 150 mg/dL, if a measured blood LDL-cholesterol level was ≥ 140 mg/dL, if a measured blood HDL-cholesterol level was < 40 mg/dL, or if the participant reported being treated for dyslipidemia.

Depressive symptoms were assessed according to the Japanese version of the Self-Rating Depression Scale (SDS) [28]. Participants were defined as depressed when the SDS score was 45 or greater [29].

Sociodemographic Factors

Sociodemographic variables, including age, educational level (lower than college level or college level and above), occupation (desk-based or not), marital status (married or unmarried), and living arrangements (alone or with others) were also assessed by a self-reported questionnaire.

Disaster-related Factors

Disaster-related factors were evaluated by the self-reported questionnaire, and participants were categorized into two or three groups based on their responses: family loss (yes or no); property damage (completely destroyed, partially damaged, or other); and work volume (unchanged, increased, or decreased).

Statistical Analysis

The distributions of all continuous variables in this study were positively skewed; therefore, they were normalized by log-transformation for our analyses. When we calculated log-transformed IES-R-J, 1.0 was added [total IES-R score+1] before transformation. Descriptive data were expressed as the median (interquartile range) for continuous variables and as percentages for categorical variables. To identify factors associated with PTSD symptoms, linear regression analysis was performed. Log-transformed total and subscale scores of IES-R-J in 2011 were used as dependent variables, and all other variables assessed in 2010 and disaster-related factors assessed in 2011 were used as independent variables. Multivariate linear regression was used to calculate slope (B), standard error (SE), and β, after controlling simultaneously for all variables, including: leg extension power (log-transformed); lifestyle-related factors: PA (<1 METs·hours/week, 1–22 METs·hours/week, or ≥23 METs·hours/week); smoking status (never, former, or current); drinking status (never, 1–6 day(s)/week, or 7 days/week); sleep duration (6–8 hours/day or not); tooth brushing (≥3 times/day or <3 times/day); and eating breakfast (<4 times/week or ≥4 times/week). Additional physical condition factors were also assessed, including: diabetes (no or yes), hypertension (no or yes), dyslipidemia (no or yes), and depressive symptoms (SDS≥45). Sociodemographic factors were also included in the analysis in the following form: age (log-transformed), education (≥ college or < college), occupation (deskwork or non-desk work), marital status (unmarried or married), and living alone (no or yes). The disaster-related factors were family loss (no or yes); property damage (other, partially damaged, or completely damaged); and work volume (unchanged, increased, or decreased). Multicollinearity was assessed by using the variance inflation factor (VIF) [30]. A VIF exceeding 10 is regarded as indicating serious multicollinearity, and values greater than 4.0 may be a cause for concern [30].

All tests for statistical significance were two-sided, and $P<0.05$ was defined as being the marker of statistical significance. All statistical analyses were performed using SPSS 17.0 for Windows (SPSS, Inc., Chicago, IL, USA).

Results

Tables 1 and 2 show the baseline characteristics for men and women, respectively. Among men, the median (interquartile range) and range of the total score of the IES-R-J among men were 10.0 (3.0–19.0) and 0.0–77.0, respectively, and the prevalence of probable PTSD (IES-R-J≥25) was 14.3%. For women, the median (interquartile range) and range of the total score of the IES-R-J were 16.0 (7.0–24.0) and 0.0–51.0, respectively, and the prevalence of probable PTSD was 24.4%. The ages of the participants ranged from 22 to 84 and 22 to 81 for men and women, respectively.

Table 1 also shows the pre-disaster factors associated with the total score of IES-R-J among men five months after the earthquake. In bivariate linear regression analysis, the total score of IES-R-J was negatively associated with having a college education ($\beta=-0.114$, $P=0.023$), leg extension power ($\beta=-0.130$, $P=0.009$), and engagement in 1–22 METs·hours/week of physical activity (<1 METs·hours/week was used as the reference, $\beta=-0.111$, $P=0.027$). Moreover, daily drinking (no drinking was used as the reference, $\beta=0.138$, $P=0.006$) and depressive symptoms ($\beta=0.132$, $P=0.008$) were positively associated with the total score of IES-R-J.

To identify the pre-disaster risk factors associated with PTSD symptoms among men, multivariate linear regression analysis was performed using all variables listed in Table 1 as independent variables. Leg extension power ($\beta=-0.128$, $P=0.025$), daily drinking ($\beta=0.203$, $P=0.006$), and depressive symptoms ($\beta=0.139$, $P=0.008$) were associated with total IES-R-J scores. Moreover, for the IES-R-J subscales, leg extension power was negatively associated with Intrusion ($\beta=-0.114$, $P=0.045$) and Hyperarousal ($\beta=-0.163$, $P=0.004$) after adjusting for the above-mentioned variables (Table 3).

On the other hand, among women (Table 2), hypertension ($\beta=0.201$, $P=0.026$) and depressive symptoms ($\beta=0.212$, $P=0.019$) were positively associated with total IES-R-J scores. In addition, family loss ($\beta=0.182$, $P=0.044$) and increased work volume after the earthquake (unchanged work volume was used as the reference, $\beta=0.210$, $P=0.020$) were associated with total IES-R-J scores. The associations of the total IES-R-J scores with hypertension ($\beta=0.226$, $P=0.032$) and depressive symptoms (β

Table 1. Participants characteristics and pre-disaster factors associated with the total score of IES-R-J in men (n = 399)[a].

	Value[b]	Bivariate analysis				Multivariate analysis			
		B	SE	β	P	B	SE	β	P
IES-R-J									
Total[c]	10.0 (3.0–19.0)								
Intrusion[c]	4.0 (1.0–7.0)								
Avoidance[c]	4.0 (1.0–8.0)								
Hyperarousal[c]	3.0 (1.0–5.0)								
IES-R-J≥25, %	14.3								
Sociodemographic factors									
Age (years)[c]	45.0 (37.0–55.0)	0.173	0.219	0.040	0.430	−0.310	0.279	−0.071	0.268
Education									
<college, %	60.4	Ref.				Ref.			
≥college, %	39.6	**−0.106**	**0.047**	**−0.114**	**0.023**	−0.088	0.049	−0.094	0.070
Occupation									
Desk work, %	51.6	Ref.				Ref.			
Non-desk work, %	48.4	0.075	0.046	0.082	0.101	0.071	0.046	0.078	0.125
Marital status									
Unmarried, %	23.1	Ref.				Ref.			
Married, %	76.9	0.010	0.054	0.009	0.853	0.075	0.072	0.069	0.294
Living alone									
No, %	89.0	Ref.				Ref.			
Yes, %	11.0	0.009	0.073	0.006	0.897	0.023	0.092	0.016	0.803
Physical function factor									
Leg extension power (W/kg)[c]	18.5 (15.0–21.8)	**−0.448**	**0.171**	**−0.130**	**0.009**	**−0.438**	**0.195**	**−0.128**	**0.025**
Lifestyle factors									
PA									
<1 METs·hours/week, %	23.8	Ref.				Ref.			
1–22 METs·hours/week, %	36.3	**−0.105**	**0.047**	**−0.111**	**0.027**	−0.075	0.062	−0.078	0.227
≥23 METs·hours/week, %	39.9	0.070	0.047	0.075	0.136	0.011	0.061	0.012	0.856
Smoking status									
Never, %	42.9	Ref.				Ref.			
Former, %	14.5	−0.091	0.065	−0.070	0.162	−0.094	0.071	−0.073	0.182
Current, %	42.6	0.071	0.046	0.077	0.124	0.006	0.052	0.007	0.901
Drinking status									
Never, %	17.3	Ref.				Ref.			
1–6 day(s)/week, %	51.1	−0.507	0.046	−0.062	0.217	0.129	0.066	0.141	0.052
7 days/week, %	31.6	**0.135**	**0.049**	**0.138**	**0.006**	**0.200**	**0.072**	**0.203**	**0.006**
Sleep duration									
6–8 hours/day, %	56.9	Ref.				Ref.			
<6 or >8 hours/day, %	43.1	−0.052	0.046	−0.056	0.265	−0.033	0.049	−0.036	0.494
Tooth brushing									
≥3 times/day, %	88.5	Ref.				Ref.			
<3 time/day, %	11.5	−0.063	0.072	−0.044	0.380	−0.024	0.074	−0.017	0.747
Eating breakfast									
<4 times/week, %	34.1	Ref.				Ref.			
≥4 times/week, %	65.9	0.025	0.048	0.026	0.607	0.040	0.051	0.041	0.431
Physical condition factor									
Diabetes									
No, %	93.0	Ref.				Ref.			
Yes, %	7.0	0.111	0.090	0.062	0.214	0.049	0.094	0.027	0.52

Table 1. Cont.

	Value[b]	Bivariate analysis				Multivariate analysis			
		B	SE	β	P	B	SE	β	P
Hypertension									
No, %	70.7	Ref.				Ref.			
Yes, %	29.3	0.045	0.050	0.045	0.371	0.009	0.056	0.008	0.880
Dyslipidemia									
No, %	53.6	Ref.				Ref.			
Yes, %	46.4	0.007	0.046	0.007	0.885	0.004	0.047	0.004	0.930
Depressive symptoms									
SDS<45, %	72.4	Ref.				Ref.			
SDS≥45, %	27.6	**0.135**	**0.051**	**0.132**	**0.008**	**0.142**	**0.053**	**0.139**	**0.008**
Disaster-related factors[d]									
Family loss									
No, %	98.7	Ref.				Ref.			
Yes, %	1.3	0.316	0.205	0.077	0.125	0.272	0.223	0.066	0.223
Property damage									
Other, %	57.2	Ref.				Ref.			
Partially-damaged, %	37.3	0.030	0.047	0.032	0.525	0.033	0.048	0.035	0.496
Completely-destroyed, %	5.5	0.165	0.100	0.083	0.100	0.092	0.111	0.046	0.404
Work volume									
Unchanged, %	54.1	Ref.				Ref.			
Increased, %	35.6	0.052	0.048	0.055	0.275	0.047	0.050	0.049	0.349
Decreased, %	10.3	0.018	0.075	0.012	0.816	0.033	0.078	0.022	0.677

[a]IES-R-J, the Japanese version of the Impact of Event Scale-Revised; PA, physical activity; METs, metabolic equivalent of tasks; SDS, Self-rating Depression Scale.
[b]Data are summarized by median (interquartile range) for continuous variables and by percentage for category variables.
[c]All continuous variables have been log-transformed.
[d]Data was measured in 2011 only.
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= 0.205, $P = 0.046$) remained significant even after adjusting for all variables listed in Table 2.

Evidence for multicollinearity was absent because the variance inflation factor for independent variables for all models in Tables 1 and 2 was less than 2.0.

Discussion

Using a one-year retrospective cohort design, this study examined the relationship between the prevalence of probable PTSD and modifiable pre-disaster factors, such as lifestyle or physical functioning. We found that, among men, lower leg extension power and daily drinking before the earthquake were associated with higher total IES-R-J scores, even after adjusting for disaster-related factors. In addition, among women, participants with hypertension before the earthquake also had higher total IES-R-J scores. Although this study has several limitations, as described below, we were able to demonstrate that pre-disaster physical functioning and condition, which were free from the direct influence of the disaster, are risk factors for probable PTSD post-disaster, owing to the evidence from the pre-existing cohort study.

Previous research examining the associations between physical functioning and mental health following disasters has been limited [12]. Tsai et al. reported that people with PTSS symptoms six months and three years after the Chi-Chi earthquake in Taiwan had poorer self-reported physical functioning than controls, and their physical component summary scores on the MOS SF-36 negatively correlated with their PTSS symptoms three years post-disaster [12]. These findings indicated that poorer mental health after the disaster had a significant negative influence on future physical functioning. However, in our study, lower pre-disaster leg extension power was associated with the severity of PTSD symptoms following the Great East Japan Earthquake. Consistent with the associations between poorer physical functioning and a higher risk of poor mental health under non-disaster conditions [10,11,31], higher pre-disaster physical functioning may have a protective influence on disaster-related probable PTSD; thus, daily maintenance and enhancement of physical functioning may primarily prevent disaster-related PTSD.

Our findings might be partly explained by behavioral mechanisms. Poorer physical functioning has been associated with fewer friendship contacts, fewer family contacts, and less perceived peer support [32]. Lower walking speed has also been associated with lower social participation as defined by taking part in social, cultural, and leisure activities [33]. Taken together, it may be the case that survivors of natural disasters with less leg extension power are sensitive to stress, as they have fewer opportunities to participate in social activities or less contact with others under disaster conditions. Thus, leg extension power might not be the sole influencing factor.

In addition to the effect of social contact, exercise per se can help people to cope with stress and other problem for life event [34,35], and exercise is recommended as a stress management technique [34]. A previous study reported that physical fitness,

Table 2. Participants characteristics and pre-disaster factors associated with the total score of IES-R-J in women (n = 123)[a].

	Value[b]	Bivariate analysis				Multivariate analysis			
		B	SE	β	P	B	SE	β	P
IES-R-J									
Total[c]	16.0 (7.0–24.0)								
Intrusion[c]	5.0 (2.0–9.0)								
Avoidance[c]	5.0 (3.0–10.0)								
Hyperarousal[c]	4.0 (2.0–7.0)								
IES-R-J≥25, %	24.4								
Sociodemographic factors									
Age (years)[c]	38.0 (35.0–50.0)	−0.141	0.311	−0.041	0.650	−0.720	0.449	−0.207	0.112
Education									
<college, %	87.8	Ref.				Ref.			
≥college, %	12.2	0.000	0.105	0.000	0.998	−0.065	0.115	−0.056	0.573
Occupation									
Desk work, %	85.4	Ref.				Ref.			
Non-desk work, %	14.6	0.014	0.098	0.013	0.884	0.009	0.111	0.008	0.937
Marital status									
Unmarried, %	50.4	Ref.				Ref.			
Married, %	49.6	−0.027	0.069	−0.035	0.698	0.052	0.095	0.068	0.583
Living alone									
No, %	87.0	Ref.				Ref.			
Yes, %	13.0	0.001	0.103	0.001	0.995	0.041	0.125	0.035	0.744
Physical function factor									
Leg extension power (W/kg)[c]	10.2 (7.9–13.2)	0.093	0.201	0.042	0.646	0.285	0.229	0.130	0.216
Lifestyle factors									
PA									
<1 METs·hours/week, %	30.1	Ref.				Ref.			
1–22 METs·hours/week, %	45.5	0.012	0.069	0.016	0.857	−0.011	0.092	−0.014	0.905
≥23 METs·hours/week, %	24.4	−0.056	0.080	−0.064	0.485	0.080	0.112	0.090	0.479
Smoking status									
Never, %	72.4	Ref.				Ref.			
Former, %	6.5	−0.118	0.139	−0.077	0.400	−0.203	0.161	−0.132	0.212
Current, %	21.1	0.042	0.084	0.045	0.622	0.038	0.097	0.040	0.700
Drinking status									
Never, %	41.5	Ref.				Ref.			
1–6 day(s)/week, %	50.4	−0.098	0.068	−0.129	0.156	−0.091	0.083	−0.120	0.274
7 days/week, %	8.1	0.115	0.126	0.083	0.362	0.155	0.147	0.112	0.291
Sleep duration									
6–8 hours/day, %	52.8	Ref.				Ref.			
<6 or >8 hours/day, %	47.2	0.015	0.069	0.020	0.827	0.004	0.079	0.005	0.959
Tooth brushing									
≥3 times/day, %	71.5	Ref.				Ref.			
<3 time/day, %	28.5	0.019	0.077	0.022	0.808	0.061	0.084	0.073	0.470
Eating breakfast									
<4 times/week, %	38.2	Ref.				Ref.			
≥4 times/week, %	61.8	0.029	0.071	0.037	0.688	0.039	0.084	0.049	0.646
Physical condition factor									
Diabetes									
No, %	98.4	Ref.				Ref.			
Yes, %	1.6	0.084	0.273	0.028	0.757	0.138	0.298	0.046	0.644

Table 2. Cont.

	Value[b]	Bivariate analysis				Multivariate analysis			
		B	SE	β	P	B	SE	β	P
Hypertension									
No, %	91.9	Ref.				Ref.			
Yes, %	8.1	**0.279**	**0.124**	**0.201**	**0.026**	**0.329**	**0.151**	**0.226**	**0.032**
Dyslipidemia									
No, %	77.2	Ref.				Ref.			
Yes, %	22.8	−0.020	0.082	−0.023	0.804	−0.026	0.100	−0.028	0.799
Depressive symptoms									
SDS<45, %	65.9	Ref.				Ref.			
SDS≥45, %	34.1	**0.169**	**0.071**	**0.212**	**0.019**	**0.164**	**0.081**	**0.205**	**0.046**
Disaster-related factors[d]									
Family loss									
No, %	98.4	Ref.				Ref.			
Yes, %	1.6	**0.545**	**0.268**	**0.182**	**0.044**	0.194	0.444	0.065	0.664
Property damage									
Other, %	50.4	Ref.				Ref.			
Partially-damaged, %	46.3	−0.030	0.069	−0.039	0.665	−0.009	0.079	−0.012	0.909
Completely-destroyed, %	3.3	0.352	0.192	0.165	0.069	0.154	0.306	0.072	0.615
Work volume									
Unchanged, %	60.2	Ref.				Ref.			
Increased, %	32.5	**0.170**	**0.072**	**0.210**	**0.020**	0.160	0.087	0.196	0.068
Decreased, %	7.3	−0.004	0.132	−0.002	0.978	0.079	0.147	0.054	0.591

[a]IES-R-J, the Japanese version of the Impact of Event Scale-Revised; PA, physical activity; METs, metabolic equivalent of tasks; SDS, Self-rating Depression Scale.
[b]Data are summarized by median (interquartile range) for continuous variables and by percentage for category variables.
[c]All continuous variables have been log-transformed.
[d]Data was measured in 2011 only.
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which is strongly related to exercise, was associated with decreased psychological distress among community-dwelling adults, and the stressor–distress relationship was moderated by physical fitness [36]. Similar association was confirmed in Gerber's study which recruited employees of police force and emergency response service corps [37]. Although mechanisms for the association are still unknown, these results suggested that physical function could buffer against the effects of real-life stress [38]. Therefore, even under disaster condition, higher physical function may be expected to have a protective effect against disaster-induced stress.

One of the strengths of our study was that the leg extension power measurement was performed before the disaster. As compared with physical performance, self-perceived measures are likely to be affected by mental conditions such as depressive symptoms, resulting in lower objectivity. Therefore, the self-reported questionnaire is more susceptible to information bias, and the influence of this bias on self-reported measures under disaster conditions can be greater than under non-disaster conditions. In addition, even a performance-based measure, like the level of physical functioning measured following a disaster could be underestimated when compared to the actual level of leg extension power. Thus, because our study used a pre-disaster measure of leg extension power, our results were less susceptible to information bias and had higher internal validity, as compared with previous studies [12].

Previous studies have reported that PTSD was associated with cardiometabolic diseases [39,40]. In a previous cross-sectional study, Australian veterans with a history of PTSD had an increased odds ratio of having hypertension [41]. Interestingly, our study demonstrated that among women, those with hypertension before the earthquake had a higher total score of IES-R-J after the disaster. In the Great East Japan Earthquake, people, including our study participants, experienced great difficulties in obtaining food and beverages, and many were without medication for more than one month, due to significant damages of the public transportation system and fuel shortage [21,42]. The relief food supplies provided in the first couple of weeks were mainly unhealthy foods and those high in carbohydrates and sodium [43], and it is very likely that people with hypertension had greater trouble controlling their diets or taking medications, because treatment of hypertension has been correlated with improvement in mood and quality of life [44]. Thus, this finding provides important clinical data regarding the need to take care of survivors being treated for hypertension when a natural disaster occurs.

Trauma exposure by natural disasters was positively associated with alcohol consumption [45], even after adjusting for pre-disaster alcohol consumption in previous studies [46]. Interestingly, in this study, pre-disaster daily drinking had a positive association with PTSD symptom severity among adult men. It was found that, after the Great Hansin Earthquake on January 17, 1995, in Japan, the quantity of alcoholic beverages sold in a disaster-stricken prefecture after the earthquake decreased after adjusting for population movement and the decreased number of retail shops after the disaster [47]. One possible reason for this

Table 3. Relationship of leg extension power with each subscale scores of IES-R-J among men and women[a].

	Men (n=399)				Women (n =123)			
	B	SE	β	P	B	SE	β	P
IES-R-J[b]								
Intrusion	−0.327	0.162	−0.114	0.045	0.200	0.215	0.099	0.355
Avoidance	−0.233	0.154	−0.086	0.131	0.159	0.199	0.085	0.428
Hyperarousal	−0.425	0.148	−0.163	0.004	0.134	0.192	0.071	0.486

[a]Adjusted for physical activiy (<1 METs·hours/week, 1–22 METs·hours/week, or≥23 METs·hours/week), smoking status (never, former, or current), drinking status (never, 1–6 day(s)/week, or 7 days/week), sleep duration (6–8 hours/day or not), tooth brushing (≥3 times/day or <3 times/day), eating breakfast (<4 times/week or ≥4 times/week), diabetes (no or yes), hypertension (no or yes), dyslipidemia (no or yes), depressive symptoms (SDS≥45), age (log-transformed), education (≥ college or < college), occupation (deskwork or non-desk work), marital status (unmarried or married), family loss (no or yes), property damage (other, partially damaged, or completely damaged), and work volume (unchanged, increased, or decreased).
[b]All continuous variables have been log-transformed.
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decrease in alcohol consumption is assumed to be the strong self-discipline of Japanese people and a culture that respects such behavior [47]. Given that stress coping is one of the motives for drinking alcohol, which also predicts the amount of alcohol consumption [48], our findings suggest that those who drank daily before the disaster had to reduce their drinking after the earthquake, which might have rendered them susceptible to stress, thereby exacerbating the severity of PTSD symptoms.

This study had several limitations. First, PTSD was not assessed by an interview; however, the IES-R seems to be a reasonable assessment method for screening probable PTSD in emergency situations such as disasters. Second, we could not exclude the influence of other factors affecting PTSD. For example, prior history of psychiatric disease is an important risk factor for developing PTSD [6], but it is difficult to precisely evaluate mental health problems in this setting, because previous reviews reported that Japanese people tend to keep a greater social distance from individuals with mental illness. Stigmatizing attitudes toward mental health patients in Japan are stronger than they are in other Asian countries [49]. Third, although we designed a retrospective cohort study, we could not exclude participants who already had PTSD in 2010. This is because the Oroshisho study was conducted in 2008 to examine risk factors for lifestyle-related illnesses, and it did not evaluate PTSD symptoms before 2011. However, we excluded those who had depressive symptoms, which is a strong risk factor for PTSD [50]. Furthermore, given that the 12-month prevalence of PTSD among Japanese adults is 0.4% [51], the influence of previous PTSD history could not have been substantial. Finally, the sample size was small, particularly lacking in women respondents, and unemployed people were not included. The generalizability of our findings to all survivors of the Great East Japan Earthquake is limited because our participants were relatively moderately harmed by the earthquake. However, given that PTSD is a common mental health problem, it is important to identify risk factors for PTSD to enable earlier detection and provide more urgent support among not only those who are severely affected with the disorder, but also those for whom PTSD even moderately affects their daily functioning.

In conclusion, the relationships between the severity of PTSD symptoms and pre-disaster factors were examined using data obtained before the disaster. The results showed that, among men, lower leg extension power and daily drinking before the earthquake were associated with higher PTSD symptom severity five months after the Great East Japan Earthquake. In addition, among women, participants with hypertension before the earthquake also had higher total IES-R-J scores. Thus, daily maintenance and improvement of physical function could be one of the primary ways to prevent declining mental health following disaster situations.

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Author Contributions

Conceived and designed the experiments: HM RN. Performed the experiments: HM KN YK CH AO MC HT. Analyzed the data: HM KN YK CH. Contributed reagents/materials/analysis tools: HM AO MC HT. Wrote the paper: HM RN.

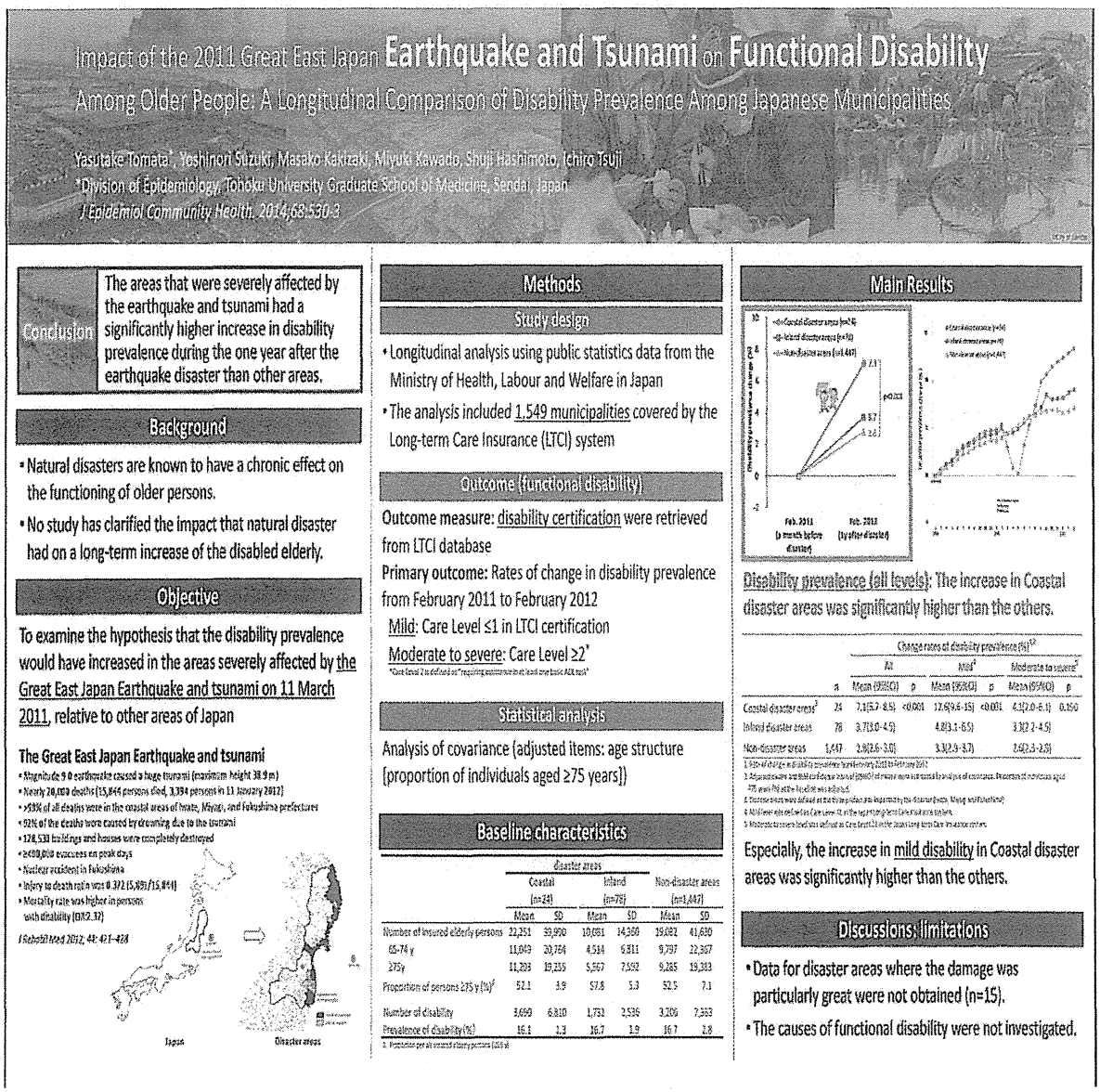
References

1. Ishigaki A, Higashi H, Sakamoto T, Shibahara S (2013) The Great East-Japan Earthquake and devastating tsunami: an update and lessons from the past Great Earthquakes in Japan since 1923. Tohoku J Exp Med 229: 287–299.
2. Shibahara S (2011) The 2011 Tohoku earthquake and devastating tsunami. Tohoku J Exp Med 223: 305–307.
3. Galea S, Nandi A, Vlahov D (2005) The epidemiology of post-traumatic stress disorder after disasters. Epidemiol Rev 27: 78–91.
4. Kessler RC (2000) Posttraumatic stress disorder: the burden to the individual and to society. J Clin Psychiatry 61 Suppl 5: 4–12; discussion 13–14.
5. Walker EA, Katon W, Russo J, Ciechanowski P, Newman E, et al. (2003) Health care costs associated with posttraumatic stress disorder symptoms in women. Arch Gen Psychiatry 60: 369–374.
6. Foa EB, Stein DJ, McFarlane AC (2006) Symptomatology and psychopathology of mental health problems after disaster. J Clin Psychiatry 67 Suppl 2: 15–25.
7. Wang L, Zhang Y, Wang W, Shi Z, Shen J, et al. (2009) Symptoms of posttraumatic stress disorder among adult survivors three months after the Sichuan earthquake in China. J Trauma Stress 22: 444–450.
8. (2012) WorldRiskReport 2012: Environmental degradation increases disaster risk worldwide. United Nations University Institute for Environment and Human Security (UNU-EHS) and Alliance Development Works/Bündnis Entwicklung Hilft and The Nature Conservancy (TNC).
9. Aberg MA, Waern M, Nyberg J, Pedersen NL, Bergh Y, et al. (2012) Cardiovascular fitness in males at age 18 and risk of serious depression in adulthood: Swedish prospective population-based study. Br J Psychiatry 201: 352–359.
10. Turvey CL, Schultz SK, Beglinger L, Klein DM (2009) A longitudinal community-based study of chronic illness, cognitive and physical function, and depression. Am J Geriatr Psychiatry 17: 632–641.

11. van Milligen BA, Vogelzangs N, Smit JH, Penninx BW (2012) Physical function as predictor for the persistence of depressive and anxiety disorders. J Affect Disord 136: 828–832.
12. Tsai KY, Chou P, Chou FH, Su TT, Lin SC, et al. (2007) Three-year follow-up study of the relationship between posttraumatic stress symptoms and quality of life among earthquake survivors in Yu-Chi, Taiwan. J Psychiatr Res 41: 90–96.
13. Min JA, Lee CU, Lee C (2013) Mental Health Promotion and Illness Prevention: A Challenge for Psychiatrists. Psychiatry Investig 10: 307–316.
14. Van der Velden PG, Grievink L, Olff M, Gersons BP, Kleber RJ (2007) Smoking as a risk factor for mental health disturbances after a disaster: a prospective comparative study. J Clin Psychiatry 68: 87–92.
15. Wang H, Jin H, Nunnink SE, Guo W, Sun J, et al. (2011) Identification of post traumatic stress disorder and risk factors in military first responders 6 months after Wen Chuan earthquake in China. J Affect Disord 130: 213–219.
16. LeardMann CA, Kelton ML, Smith B, Littman AJ, Boyko EJ, et al. (2011) Prospectively assessed posttraumatic stress disorder and associated physical activity. Public Health Rep 126: 371–383.
17. Niu K, Kobayashi Y, Guan L, Momma H, Guo H, et al. (2013) Low-fat dairy, but not whole−/high-fat dairy, consumption is related with higher serum adiponectin levels in apparently healthy adults. Eur J Nutr 52: 771–778.
18. Kobayashi Y, Niu K, Guan L, Momma H, Guo H, et al. (2012) Oral health behavior and metabolic syndrome and its components in adults. J Dent Res 91: 479–484.
19. Guo H, Niu K, Monma H, Kobayashi Y, Guan L, et al. (2012) Association of Japanese dietary pattern with serum adiponectin concentration in Japanese adult men. Nutr Metab Cardiovasc Dis 22: 277–284.
20. Momma H, Niu K, Kobayashi Y, Huang C, Chujo M, et al. (2013) Lower Serum Endogenous Secretory Receptor for Advanced Glycation End Product Level as a Risk Factor of Metabolic Syndrome Among Japanese Adult Men: A 2-Year Longitudinal Study. J Clin Endocrinol Metab.
21. Sugimoto A (2011) Toward the second stage of recovery from the 3.11 Tohoku Earthquake. Genes Cells 16: 745–747.
22. Weiss DS, Marmar CR (1997) The Impact of Event Scale-Revised. In: J.P. Wilson TMK, editor. Assessing Psychological Trauma and PTSD: A Practitioner's Handbook. New York: Guilford Press. pp. 399–411.
23. Asukai N, Kato H, Kawamura N, Kim Y, Yamamoto K, et al. (2002) Reliability and validity of the Japanese-language version of the impact of event scale-revised (IES-R-J): four studies of different traumatic events. J Nerv Ment Dis 190: 175–182.
24. Bassey EJ, Short AH (1990) A new method for measuring power output in a single leg extension: feasibility, reliability and validity. Eur J Appl Physiol Occup Physiol 60: 385–390.
25. Murase N, Katsumura T, Ueda C, Inoue S, Shimomitsu T (2002) Validity and reliability of Japanese version of International Physical Activity Questionnaire. Journal of Health and Welfare Statistics [In Japanese] 49: 1–9.
26. Ishikawa-Takata K, Tabata I (2007) Exercise and Physical Activity Reference for Health Promotion 2006 (EPAR2006). J Epidemiol 17: 177.
27. Sasaki S (2005) Serum Biomarker-based Validation of a Brief-type Self-administered Diet History Questionnaire for Japanese Subjects, The Study Group of Ministry of Health, Labor and Welfare of Japan, Tanaka H, chairman, "A research for assessment of nutrition and dietary habit in "Kenko Nippon 21". 10–42 (in Japanese).
28. Fukuda K, Kobayashi S (1973) A study on a self-rating depression scale (author's transl). Seishin Shinkeigaku Zasshi 75: 673–679. (in Japanese).
29. Fountoulakis KN, Iacovides A, Samolis S, Kleanthous S, Kaprinis SG, et al. (2001) Reliability, validity and psychometric properties of the Greek translation of the Zung Depression Rating Scale. BMC Psychiatry 1: 6.
30. Glantz SA, Slinker BK (1990) Primer of applied regression and analysis of variance: McGraw-Hill New York.
31. Rhebergen D, Batelaan NM, de Graaf R, Nolen WA, Spijker J, et al. (2011) The 7-year course of depression and anxiety in the general population. Acta Psychiatr Scand 123: 297–306.
32. Newsom JT, Schulz R (1996) Social support as a mediator in the relation between functional status and quality of life in older adults. Psychol Aging 11: 34–44.
33. Ekstrom H, Dahlin-Ivanoff S, Elmstahl S (2011) Effects of walking speed and results of timed get-up-and-go tests on quality of life and social participation in elderly individuals with a history of osteoporosis-related fractures. J Aging Health 23: 1379–1399.
34. Rostad F, Long B (1996) Exercise as a coping strategy for stress: a review. International Journal of Sport Psychology 27: 197–222.
35. Salmon P (2001) Effects of physical exercise on anxiety, depression, and sensitivity to stress: a unifying theory. Clin Psychol Rev 21: 33–61.
36. Ensel WM, Lin N (2004) Physical fitness and the stress process. Journal of Community Psychology 32: 81–101.
37. Gerber M, Kellmann M, Hartmann T, Pühse U (2010) Do exercise and fitness buffer against stress among Swiss police and emergency response service officers? Psychology of Sport and Exercise 11: 286–294.
38. Gerber M, Puhse U (2009) Do exercise and fitness protect against stress-induced health complaints? A review of the literature. Scand J Public Health 37: 801–819.
39. Levine AB, Levine LM, Levine TB (2013) Posttraumatic Stress Disorder and Cardiometabolic Disease. Cardiology 127: 1–19.
40. Dedert EA, Calhoun PS, Watkins LL, Sherwood A, Beckham JC (2010) Posttraumatic stress disorder, cardiovascular, and metabolic disease: a review of the evidence. Ann Behav Med 39: 61–78.
41. Abouzeid M, Kelsall HL, Forbes AB, Sim MR, Creamer MC (2012) Posttraumatic stress disorder and hypertension in Australian veterans of the 1991 Gulf War. J Psychosom Res 72: 33–38.
42. Ishii M, Nagata T, Aoki K (2011) Japan Medical Association's Actions in the Great Eastern Japan Earthquake. World Medical & Health Policy 3: Article 2.
43. Nishimura K (2011) Diet and Nutrition Issues in the Disaster Area-Report on the Affected Areas of Tohoku Region Pacific Coast Earthquake (Kesennuma-City, Miyagi). Journal of the Japan Diabetes Society (in Japanese) 54: 724–726.
44. Muller A, Montoya P, Schandry R, Hartl L (1994) Changes in physical symptoms, blood pressure and quality of life over 30 days. Behav Res Ther 32: 593–603.
45. Keyes KM, Hatzenbuehler ML, Hasin DS (2011) Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. Psychopharmacology (Berl) 218: 1–17.
46. Cerda M, Tracy M, Galea S (2011) A prospective population based study of changes in alcohol use and binge drinking after a mass traumatic event. Drug Alcohol Depend 115: 1–8.
47. Shimizu S, Aso K, Noda T, Ryukei S, Kochi Y, et al. (2000) Natural disasters and alcohol consumption in a cultural context: the Great Hanshin Earthquake in Japan. Addiction 95: 529–536.
48. Abbey A, Smith MJ, Scott RO (1993) The relationship between reasons for drinking alcohol and alcohol consumption: an interactional approach. Addict Behav 18: 659–670.
49. Ando S, Yamaguchi S, Aoki Y, Thornicroft G (2013) Review of mental-health-related stigma in Japan. Psychiatry Clin Neurosci 67: 421–432.
50. Lee CS, Chang JC, Liu CY, Chang CJ, Chen TH, et al. (2009) Acculturation, psychiatric comorbidity and posttraumatic stress disorder in a Taiwanese aboriginal population. Soc Psychiatry Psychiatr Epidemiol 44: 55–62.
51. Kawakami N, Takeshima T, Ono Y, Uda H, Hata Y, et al. (2005) Twelve-month prevalence, severity, and treatment of common mental disorders in communities in Japan: preliminary finding from the World Mental Health Japan Survey 2002–2003. Psychiatry Clin Neurosci 59: 441–452.

【学会発表】

1. Tomata Y, Suzuki Y, Kakizaki M, Kawado M, Hashimoto S, Tsuji I. Impact of the 2011 Great East Japan Earthquake and Tsunami on functional disability among older people: a longitudinal comparison of disability prevalence among Japanese municipalities. 20th IEA World Congress of Epidemiology (Poster), アンカレッジ, 2014年.



2．中村智洋，中谷直樹，土屋菜歩，辻　一郎，寶澤　篤，富田博秋．
東日本大震災での笑いの規程要因と精神的健康度の推測：七ヶ浜健康増進プロジェクト．
第73回日本公衆衛生学会総会（口演），宇都宮，2014年．

O-1001-5　東日本大震災での笑いの規定要因と精神的健康度の推測：七ヶ浜健康増進プロジェクト

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【目的】東日本大震災から3年以上が経ち、震災によるストレス、心の健康などによる健康への悪影響が心配される。笑いの頻度は背後に隠れるメンタル・ストレス要因と強く関連することが予想される。簡単な笑いの質問をすることで、どの程度メンタル・ストレス要因を予想できるか検討した。
【方法】東北大学は七ヶ浜町との共同事業「七ヶ浜健康増進プロジェクト」として、町内で家屋が大規模半壊、全壊（以降、「大規模半壊以上」と称す）の被害に遭われた方々に加え、半壊以下の被害に遭われた方々（特定の5地区の全員を対象）に、現在の健康全般や生活の状態を把握するため調査を計画した。この調査は平成24年10月から調査票を配布し（前半は大規模半壊以上の地域、後半は半壊以下の地域とした）、調査票は東北大学と七ヶ浜町が委託した民間業者の調査員が世帯ごとに手渡しにより配布し、同調査員が回収した。調査対象者数は7036人であり、6840人（97％）に配布した。また、4949人（70％）より有効回答を得た。本解析では、7つの要因「被災の程度、災害ストレス、CES-D[抑うつ]、ストレスcoping、K6[心理的苦痛]、PTSR、震災後の変化」に着目して評価した。またPTSRと震災後の変化については主成分分析による1つの合成変数「PTSR#」を作成し、その主成分得点を用いた（累積寄与率70%以上で総合評価として解釈できるものであった）。大規模半壊以上の地域の20歳以上で、6要因に欠損のない方を対象とした所、1633人（23%）が解析対象となった。統計解析は、目的変数を笑う頻度とし、調整項目として性別、年齢、喫煙、飲酒、経済的状況、人とのつながりに関する項目を共変量、説明変数を6要因（6つの点数）とした重回帰分析を行った。
【結果】災害ストレス、CES-D、K6の点数が高い、ストレスcopingの点数が低い方（ストレスへの対処が弱い方）は笑う頻度がそうでない人と比べ低かった。また、重回帰分析を行ったところ、笑う頻度に影響を及ぼす要因としてCES-D高値、K6高値、PTSR#高値、ストレスcoping低値の者は笑う頻度が少なかった（p値＜0.05）。
【結論】笑う頻度の少ない者は上記のような問題点をもつ可能性がそうでない者と比べて高く注意が必要である。笑う頻度の確認がメンタル・ストレス要因をもつ者の予測に役立つ可能性が示された。

3．中谷直樹，中村智洋，土屋菜歩，辻　一郎，寶澤　篤，富田博秋，
東日本大震災の被災地における慢性疾患治療と就労関連：七ヶ浜健康増進プロジェクト．
第73回日本公衆衛生学会総会（口演），宇都宮，2014年．

O-2002-1　東日本大震災の被災地における慢性疾患治療と就労の関連：七ヶ浜健康増進プロジェクト

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【目的】東日本大震災から3年以上が経ち、被災者の就労問題が顕在化している。一方、近年、がんなどの慢性疾患患者の就労支援の重要性が指摘されている。本研究では、東日本大震災の被災地における慢性疾患治療と就労の関連を横断研究にて検討した。

【方法】東北大学は宮城県七ヶ浜町との共同事業「七ヶ浜健康増進プロジェクト」として、町内で家屋の被害に遭われた方々（特定の5地区の全員を対象）に、現在の健康全般や生活の状態を把握するため調査を計画した。平成24年10月から、東北大学と七ヶ浜町が委託した民間業者の調査員が世帯ごとに調査票を手渡しし、回収した。調査対象者数は7036人であり、6840人（97％）に配布した。また、4949人（70％）より有効回答を得た。解析対象者は20歳－64歳の者2708人（38％）のうち、「現在の仕事の状況（有職、無職）」に欠損のない2679人（38％）とした。本研究では、がん、脳卒中、心筋梗塞のうち1つでも疾患を治療中と回答した者を慢性疾患治療者と定義した。統計解析は、多変量ロジスティク回帰分析を用い、慢性疾患治療「なし者」に対する「あり者」の無職オッズ比（95％信頼区間）を算出した。共変量は年齢、性、飲酒、震災による家屋の被害の程度とした。また、心理的苦痛の程度が低く（K6≦12）、身体的活動状況が良好な者のみ（掃除・重いものを持ち上げる活動を行う、外出する、座る・寝て過ごす時間が短い）（2060人）での解析も行った。

【結果】解析対象者のうち、慢性疾患治療者は98人（がん36人、脳卒中8人、心筋梗塞56人）であり、また無職者は680人であった。全対象者では、慢性疾患治療「なし者」に対する「あり者」の無職オッズ比（95％信頼区間）は、1.7（1.1-2.7）と有意にリスクが高かった（p=0.02）。一方、心理的苦痛の程度が低く、身体的活動状況が良好な者のみの解析では、慢性疾患治療「なし者」に対する「あり者」の無職オッズ比は、1.3（0.7-2.3）であり、統計学的に有意な関連を示さなかった（p=0.38）。

【結論】東日本大震災の被災地において、慢性疾患治療者の無職者の割合が高かったが、心理的苦痛が高く、身体活動状況が不良な者を除外した時、両者の関連は示されなかった。慢性疾患治療と就労の関連は、身体・心理面が介在する可能性が示された。

4．菅原由美，遠又靖丈，渡邉　崇，杉山賢明，海法　悠，柿崎真沙子，辻　一郎.
東日本大震災後の飲酒量増加に関する要因の検討.
第 73 回日本公衆衛生学会総会（ポスター），宇都宮，2014 年.

P-0101-8　東日本大震災後の飲酒量増加に関連する要因の検討

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【目的】東日本大震災被災者における飲酒量の増加が報告されている。本研究の目的は、飲酒量の増加に関連する要因を解明することである。
【方法】東北大学地域保健支援センターでは、震災後から半年ごとに被災者健康調査を実施している。第6期調査にあたる2013年11月、宮城県石巻市2地区（牡鹿、雄勝地区）の住民（5032名）と過去5回の調査に回答のあった地区外の住民（450名）、合計5482名を対象に自記式アンケート調査票を配布し、2341名（42.7%）から有効回答が得られた。このうち、研究非同意者（48名）、飲酒習慣の質問に未回答者（202名）、現在非飲酒者（1386名）を除外し、現在飲酒者705名（男性532名、女性173名）を解析対象とした。「震災前と比較して飲酒量が増加したかどうか」の質問に「はい」と回答した者を増加群、「いいえ」または未回答であった者を維持群として、飲酒量の増加に関連する要因について、ロジスティック回帰分析を用いて、オッズ比と95%信頼区間（CI）を算出した。
【結果】震災後に飲酒量が増加したと回答した者は192名（全体の27.2%）で、男性136名（同25.6%）、女性56名（同32.3%）であった。ロジスティック回帰分析により、飲酒量の増加と有意に関連する要因は、64歳以下（オッズ比1.82（95% CI：0.35-0.85））、アテネ不眠尺度6点以上（オッズ比2.56（95% CI：1.72-3.81））および喫煙（オッズ比1.72（95% CI：1.18-2.51））であった。さらに、年齢で層別化すると、64歳以下では経済状況の苦しさ（オッズ比1.78（95% CI：1.11-2.83））、65歳以上では地域のつながりの低さ（オッズ比3.61（95% CI：1.07-12.10））で飲酒量増加のオッズ比が有意に高かった。
【結論】震災から2年8ヶ月後の調査で、被災地域では飲酒者の27.2%に飲酒量の増加が見られた。飲酒量の増加要因として、年齢、睡眠障害、喫煙が影響していたが、若年者では経済状況、高齢者では地域とのつながりが強く影響していた。被災地における多量飲酒者へのアプローチとして、若年者では生計を支援する施策、高齢者では地域のつながりを強化する支援活動が必要であることが示された。

5．土屋菜歩，中谷直樹，中村智洋，辻　一郎，寶澤　篤，富田博秋．
ソーシャルキャピタルと健康状態との関連―家屋の被害程度と交互作用の検討．
第73回日本公衆衛生学会総会（ポスター），宇都宮，2014年．

P-0801-6　ソーシャルキャピタルと健康状態との関連－家屋の被災程度との交互作用の検討

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東北大学東北メディカルメガバンク機構[1)]、東北大学大学院医学系研究科[2)]、東北大学災害科学国際研究所[3)]

【目的】本研究では、震災から1.5年経過した被災地における横断調査のデータを用い、ソーシャルキャピタル（SC）と抑うつ、心理的苦痛、主観的健康感の関連が家屋の被害程度により異なるかを検討した。
【方法】東北大学は宮城県七ヶ浜町との共同事業「七ヶ浜健康増進プロジェクト」として、町内で家屋が大規模半壊、全壊の被害に遭われた方々に加え、半壊以下の被害に遭われた方々（特定の5地区の全員を対象）に、現在の健康全般や生活の状態を把握するため調査を計画した。平成24年10月から調査票を配布、回収した。調査対象者数は7036人であり、6840人（97％）に配布し4949人（70％）より有効回答を得た。認知的SCと、抑うつ、心理的苦痛、主観的健康感との関連を検討した。統計解析はロジスティック解析を用い、認知的SC高値群に対する低値群の抑うつ（CES-D＞16）、心理的苦痛（K6＞13）、主観的健康感不良のオッズ比（95%信頼区間）を算出した。家屋の被害程度については層化した解析を行い、認知的SCとの交互作用の有無を確認した。多変量解析の共変量として、性別、年齢、喫煙、飲酒、就業状況、慢性疾患の既往、震災による家屋の被害程度を加えた。
【結果】認知的SCの尺度で一般的信頼感の有無に関する多変量解析の対象者のうち、抑うつありは17.7%（412/2328）、心理的苦痛ありは4.8%（134/2811）、主観的健康感不良者が18.6%（525/2822）であった。一般的信頼感高値者vs低値者の抑うつの有病率は大規模半壊以上で15% vs 32%、半壊未満では12% vs 21%であった。家屋の被害程度による交互作用は認められなかった。両群を統合して多変量解析を行った結果、一般的信頼感低値者は抑うつ（OR=2.33 95%CI:1.86－2.86）、心理的苦痛（OR=5.88 95%CI:3.85-8.33）、主観的健康感不良（OR=1.69 95%CI:1.37-2.08）のリスクが独立して有意に高かった。他の認知的SCの項目も同様の結果であった。
【結論】被災地の住民において、ソーシャルキャピタルは家屋の被害程度に関わらず種々の健康指標と関連していた。元々の有病率の高い、家屋の被害程度が大きい集団で絶対リスクの減少程度が大きかった。

6．海原純子，錦谷まりこ，辻　一郎，大塚耕太郎．
被災地における繋がりと主観的健康観、生活満足度について
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P-0801-8　被災地における繋がりと主観的健康観、生活満足度について

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【目的】東日本大震災から3年が経過し、仮設に住む人々の中で転居する人も増え、被災者の地域での繋がりの変化が示唆されている。一方人々の繋がりは心身の健康や幸福感とかかわりがあることが近年明らかにされている。今回我々は被災地に住む住民1263名の繋がりと主観的健康観、生活満足度のかかわりについて検討を行った。
【方法】平成25年12月から平成26年3月まで宮城、岩手両県8か所で行われた心の健康サポート講演会参加者に任意で参加協力を求め、質問票による調査用紙を配布し参加者1323名の内1263名から回答を得た。質問内容は基本属性をふくむ32問で、支援活動の有無、主観的健康観、K6、就業状態、主観的経済観、震災後の転居の有無、震災後の経済的変化の有無、心に負担を感じていることで人に相談しにくいことの有無、生活満足度、周囲の人との繋がりなどである。
【結果】現在の主観的健康状態については良いと回答した人が81％、不良と答えた人が19％であり、K6については、4点以下は、19％、5－9点が50％、10点以上が32％であった。地域との繋がりについては、まわりの人々はお互いに助け合っている、まわりの人は信頼できる、まわりの人は互いに挨拶している、何か問題が生じた場合、人々は力を合わせ解決しようとする。という項目に、強くそう思う、と回答した場合4点、どちらかといえばそう思うを3点、どちらともいえないを2点、どちらかといえばそう思わないを1点、全くそう思わないを0点とし得られた得点の総合を9点未満を繋がりが弱い、9点以上を繋がりが強い、とした。繋がりが強い人は回答者のうち87％、弱い人は13％であった。地域との繋がりが強い女性は弱い女性に比べ主観的な健康状態が良好でありK6で心の健康状態が良好な人が有意に多かった。一方男性では繋がりの強弱で主観的健康状態や心の健康状態において有意差は認められなかった。地域との繋がりの強い人は弱い人に比べ男女とも生活満足度が高かった。地域との繋がりの強い女性は弱い女性に比べ震災後経済的に苦しくなったと答える人は少なく、相談しにくい悩みを持つ人が少なかった。
【結論】地域との繋がりは心身の健康状態や生活満足感とかかわりを持つ。今後ともネットワークを高める活動は望まれる。

7．伊藤久美子，遠又靖丈，小暮真奈，菅原由美，渡邉　崇，柿崎真沙子，辻　一郎.
東日本大震災の被災高齢者における転居先の住宅と運動機能低下に関する前向き研究.
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P-1301-6　東日本大震災の被災高齢者における転居先の住宅と運動機能低下に関する前向き研究

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【目的】東日本大震災発生後、被災地沿岸部において要介護認定率が著しく増加した。長期の避難生活は運動機能へ大きな影響を与えることが懸念される。一方で、被災高齢者の転居先と運動機能低下の関連は明らかではない。本研究の目的は、被災高齢者の転居先と運動機能低下の関連を明らかにすることである。
【方法】震災後の2012年5～7月と2013年5～6月に、宮城県石巻市牡鹿地区・雄勝地区にて問診・自記式質問票によって健康状態や生活習慣などを把握する「被災者健康調査」を実施した。本研究では、「被災者健康調査」の参加者のうち研究同意を得た65歳以上の者832名から、2回の調査とも基本チェックリストの回答を得て、ベースライン時（震災1年後）の転居先の住宅の種類に回答が得られた545名を対象とした。曝露要因は、ベースライン時の住宅の種類とし、「震災前と同じ（転居なし）」「プレハブ型仮設住宅」「賃貸住宅・みなし仮設」「家族・親戚・友人宅」「新居」の5つに分類した。アウトカム指標は、運動機能として基本チェックリストの「運動項目」（5項目、最大5点）を用いた。この指標が、ベースライン時から1年間の平均変化値よりも+1SD以上（2点以上）の者を「運動機能低下」と定義した。「震災前と同じ」を基準として「プレハブ型仮設住宅」「賃貸住宅・みなし仮設」「家族・親戚・友人宅」「新居」の運動機能低下のオッズ比と95%信頼区間（95%CI）をロジスティック回帰分析によって算出した。
【結果】運動機能低下者の割合は、「震災前と同じ」11.2%、「プレハブ型仮設住宅」14.7%、「賃貸住宅・みなし仮設」18.8%、「家族・親戚・友人宅」7.1%、「新居」0.0%であった。「震災前と同じ」と比べた運動機能低下の多変量調整オッズ比（95%CI）は、「賃貸住宅・みなし仮設」2.53（1.05-6.11）で有意に高かった。なお「プレハブ型仮設住宅」1.68（0.90-3.15）、「家族・親戚・友人宅」0.55（0.10-2.90）で、有意差は認められなかった。
【結論】「震災前と同じ（転居なし）」の高齢者と比べ、「賃貸住宅・みなし仮設」へ転居した高齢者は運動機能低下リスクが高かった。以上のことから、災害発生時に転居が必要となる場合、「賃貸住宅・みなし仮設」へ転居する高齢者は運動機能低下リスクが高くなる可能性があることを念頭に置く必要がある。