185 Alzheimer 病と Parkinson 病における認知機能障害の鑑別診断についての多施設共同研究

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【目的】Parkinson 病（PD）の認知機能障害スクリーニングとして最適とされる Montreal Cognitive Assessment（MoCA）によって，Alzheimer 病（AD）と PD with dementia（PD-D）の鑑別が可能かどうかを検討した．【方法】13 施設の AD と PD 患者を対象とした横断研究．認知機能は MoCA と MMSE で評価した．各施設倫理委員会の承認と対象患者の書面による同意を得た．【結果】対象は AD 97 例（年齢 78.4±5.9 歳，m±SD）と PD 304 例（年齢 70.6±8.3 歳，HY 2.7±0.7 度）．AD 患者は MoCA 得点により高得点群（17-24 点，35 例），中得点群（12-16 点，31 例），低得点群（3-11 点，31 例）に分けられた．PD 患者は MoCA 得点により高得点群（24-30 点，108 例），中得点群（19-23 点，98 例），低得点群（5-18 点，98 例）に分けられた．AD 高得点群を，MoCA 得点と年齢でマッチさせた PD 患者群と比較すると，trail making（26%：51%）と見当識（76%：95%）の得点は AD で低く，計算（92%：76%）の得点は PD で低かった．両群で MMSE の 3 段階口頭指示（68%：86%）を比べると AD の方が低く，感度 0.80，特異度 0.77 で鑑別できた．【考察】認知症ではない患者が含まれる PD の MoCA 得点は，当然 AD よりも高く分布したが，AD 高得点群にマッチさせた PD のほとんどは PD-D と考えられる．MoCA と MMSE の特定の課題の組み合わせは AD と PD-D の鑑別に有用である．

186 東日本大震災により仮設住宅に入居した高齢者における認知機能の評価

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【目的】東日本大震災後多くの高齢者が避難生活を余儀なくされている．当科では 2012 年から宮城県気仙沼市の仮設住宅に居住する高齢者を対象とした前向きコホート研究を開始した．第 1 回調査をもとに，認知機能，日常生活動作等について評価した．

【対象】東日本大震災発生時に気仙沼市に居住しており，その後市内および近隣の仮設住宅に居住する 65 歳以上の高齢者．

【方法】アンケート調査，簡易認知機能検査を施行した．アンケート内容は被災状況や健康状態，精神状態，日常生活等であり，簡易認知機能検査ではタッチパネル式の「物忘れ相談プログラム」（日本光電社 MSP-1000）を使用した．

【結果】562 名（男性 202 名，女性 360 名，平均年齢 76.3±6.0 歳）より簡易認知機能検査及びアンケート結果を得た．簡易認知機能検査（15 点満点，正常：13≦，認知症の疑い：11～12，ほぼ認知症：10≧）では，平均 12.4±2.5 点，正常 63.5%（357 例），認知症疑い 21.2%（119 例），ほぼ認知症 15.3%（86 例）であった．Lawton の Instrumental ADL の平均値は，男性 4.3±1.0 点，女性 6.8±1.9 点であった．

【結論】避難生活でアルツハイマー病患者の症状が悪化した報告があり，精神的身体的機能低下が危惧される．今回と今後のの結果を踏まえ，災害時の高齢者に対するマネージメントプログラムを策定する予定である．

187 グループホームで暮らす認知症高齢者の主観的 QOL と関連する因子の検討

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［はじめに］主観的 QOL は認知症高齢者の治療介入の重要なアウトカムのひとつである．現在まで，施設介護を受けている認知症高齢者の主観的 QOL に関する研究は少ない．

［目的］本研究の目的は，グループホームで暮らす認知症高齢者を対象に，主観的 QOL とそれに関連する因子を探索することである．

［方法］19 ヶ所のグループホームに入所中の計 80 名の認知症高齢者を対象に，2012 年 8 月から 2013 年 4 月に調査を行った．基本情報は性別，年齢，入所期間を用いた．対象者からは主観的 QOL を評定する QOL-AD と MMSE，痛みを，ケアスタッフからは HADLS，CSDD，NPI-NH，介護負担度を評価した．CDR は，対象者の面接時の情報とスタッフからの情報を基に評定した．主観的 QOL に関連する因子を特定するため，QOL-AD を従属変数として，性別，年齢，入所期間，MMSE，痛み，CDR，HADLS，CSDD，NPI-NH，介護負担度を独立変数としてステップワイズ重回帰分析を用いた．本研究は信州大学医学部医倫理審査会の承認を得ている．

［結果］QOL-AD と有意に関連する因子は，HADLS（$\beta=-0.424$，$P<0.001$）であった．

［考察］グループホームで暮らす認知症高齢者の主観的 QOL に IADL を含む日常生活動作が関連することが示された．主観的 QOL の向上には，IADL を含む日常生活動作への介入が効果的である可能性が示唆された．

188 認知機能障害を有する高齢者の治療同意能力についての検討

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患者の治療同意能力の評価は現在ほぼ主治医に一任されているが，主治医の主観的な判定は信頼性が低いことが知られている．これまでいくつかの評価法が開発されてきたが，認知症高齢者を対象に日本語で行える評価法は少ない．そこで我々は，Grisso らが開発した MacArthur Competence Assessment Tool-Treatment を基に，アルツハイマー病（AD）患者に対するドネペジル開始場面を想定した治療同意能力評価法の日本語版を作成し，患者群（軽度 AD＋健忘型軽度認知機能障害）と対照群に対して評価を行った．我々の検討では，患者群は情報の理解と認識，論理的思考に関する項目で対照群と比べて有意に低得点であったが，選択を表明する能力は対照群と比べて同等であった．これらの結果からは，患者群では，治療同意能力に関わる機能が均一に障害されているわけではない可能性と，記銘力低下のため提示された情報が保持できず，情報をもとに論理的に思考する能力が低下している可能性が示唆された．続いて上記の評価法を用いた評価と主治医の主観的な評価とを比較した．78% の患者では両者が一致した評価となったが，22% の患者では主治医が同意能力ありと判定したが，評価法を用いた評価者は同意能力なしと判定した．主治医が同意能力なしとしたが，評価法を用いた評価者が同意能力ありとした例はなかった．この結果からは特に注意を払わないと治療同意能力を高く見積もる可能性が示唆された．

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東日本大震災後の認知症の調査

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【目的】大規模災害による大きな環境の変化は我々の健康状態に変化を及ぼすことは想像に難くない．我々は2011年3月11日に発生した東日本大震災後の認知症の症状の変化について調査検討を行った．【方法】被災したアルツハイマー病(AD)患者を対象に認知機能と精神行動異常 (Behavioral Psychological Symptoms of Dementia: BPSD) の変化を調査検討した．宮城県内の2つの病院において震災2-4か月後および12-15か月後にAD患者を対象に神経心理検査Minimental State Examination (MMSE) とNeuropsychiatric Inventory Questionnaire (NPI-Q) を施行し，(A群) 非被災群 (M/F=9/11)，(B群) 避難所生活をしなかった被災群 (M/F=9/9)，(C群) 避難所生活をした被災群 (M/F=8/9) の3群に分けて比較検討した．【結果】震災後2-4か月後のMMSEの震災前に比べての震災後の増悪度は，非被災群 (A群) に比し，避難所生活をしなかった被災群 (B群)，避難所生活をした被災群 (C群) とも大きかった．NPI-Qの震災前に比べての震災後の増悪度は非被災群 (A群) に比し，避難所生活をしなかった被災群 (B群)，避難所生活をした被災群 (C群) とも大きく，かつC群はB群に比し増悪度が大きかった．すなわち非被災者に比し被災者は，震災直後，認知機能，BPSDとも有意に増悪していることが明らかになり，かつその程度は避難所生活を強いられた患者に顕著であった．また震災12-15か月後のMMSEおよびNPI-Qは，いずれの群においても数値の改善を認めたが，震災前のレベルには復帰していなかった．【結論】今回の大震災による被害の中心が東北地方の沿岸部であったこともあり，被災者の多くは高齢者であり，認知症患者も多く含まれている．避難所生活を強いられた認知症患者が精神的に混乱し，認知症症状の変化をきたしたことは非常に残念な結果であった (Lancet 377 (9778) : 1652, 2011, J Neurol 259 (6) : 1243, 2012.)．

臨床神経学 p.1591 53: 2013

東北における認知症研究と診療
分子イメージングから震災復興まで

Clinical and Research Activities in Tohoku: From Molecular Imaging to Disaster Recovery

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古川勝敏*

1. 分子イメージング

我々、東北大学老年医学分野は、認知症の研究として PET を用いた分子イメージングを積極的に推進している。アルツハイマー病（AD）の特徴的な病理所見として「老人斑」があり、その老人斑の主要構成成分がアミロイドβ蛋白質（Aβ）である。さらに Aβの前駆体であるアミロイド前駆体蛋白質（Amyloid precursor protein: APP）の遺伝子変異により家族性 AD が発症することも知られており、現在Aβを除去する薬剤が抗AD薬の候補として盛んに開発が続いている。これらの背景によりAβはADの最も重要なkey moleculesの一つであると認識されている。AD の病態をより正確に把握し、治療の評価をするためには Aβの定量、画像化は必須の命題だと言えるが、これまで老人斑または Aβを確認するのには死後脳を用いた病理学的、生化学的解析しか手法がなく、生きている患者の老人斑または Aβの確認は非常に困難であった。我々のグループは東北大学オリジナルのアミロイドに特異的に結合する PET プローブ:BF227 を開発し、この PET プローブを用い健常高齢者、軽度認知機能障害（Mild cognitive impairment:MCI）、AD においてアミロイド PET を施行した。AD 群は健常高齢者群に比べ有意に BF227 の集積が亢進しており、Aβの沈着を示唆する結果が得られた。また MCI 群は、健常高齢者群と AD 群の中間の集積が確認された。さらに MCI 群を 2 年間追跡すると AD に進行する群と進行しない群に分かれる。これらの 2 群において時間を遡ってアミロイド PET の結果を解析すると、AD への進行した MCI 群は非進行の MCI 群に比べ BF227 の集積が亢進していることが明らかになった。これは言葉を変えれば BF227 の PET により AD の超早期診断が可能になったと言えるかもしれない（Furukawa et al. *J Neurol* 2010）。

またこの BF227 を全身性のアミロイドーシスの患者にも応用し PET 解析をおこなった。心筋へのトランスサイレチンというアミロイド分子の沈着が示唆される Familial amyloid polyneuropathy の患者においての BF227-PET では、心筋への BF227 の高集積が確認された（Furukawa et al. *Circulation* 2011）。

2. 震災復興

大規模災害による大きな環境の変化は我々の健康状態に変化を及ぼすことは想像に難くない。我々は 2011 年 3 月 11 日に発生した東日本大震災後の認知症の症状の変化について調査検討を行った。被災した AD 患者を対象に認知機能と精神行動異常（Behavioral and Psychological Symptoms of Dementia: BPSD）の変化を調査検討した。宮城県内の 2 つの病院（東北大学病院、こだまホスピタル）において震災 2-4 か月後および 12-15 か月後に AD 患者を対象に神経心理検査 Minimental State Examination（MMSE）と Neuropsychiatric Inventory Questionnaire（NPI-Q）を施行し、（A 群）非被災群（M/F=9/11）、（B 群）避難所生活をしなかった被災群（M/F=9/9）、（C 群）避難所生活をした被災群（M/F=8/9）の 3 群

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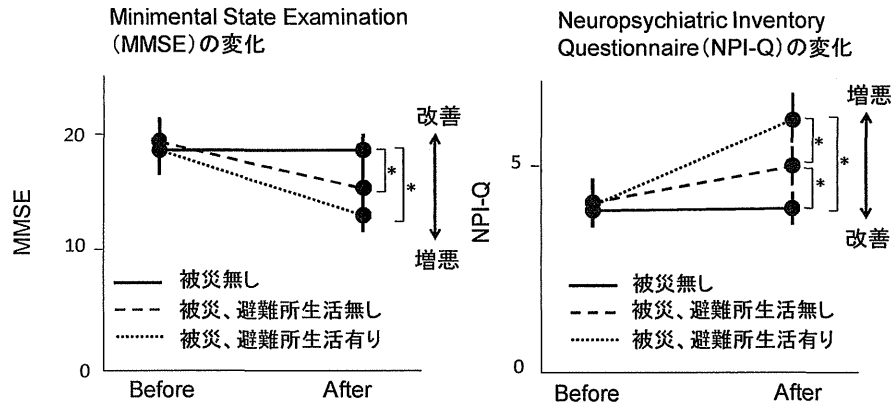

図　東日本大震災後の認知症の症状の変化

に分けて比較検討した（図）。震災後 2-4 か月後の MMSE の震災前に比べての震災後の増悪度は、非被災群（A 群）に比し、避難所生活をしなかった被災群（B 群）、避難所生活をした被災群（C 群）とも大きかった。NPI-Q の震災前に比べての震災後の増悪度は非被災群（A 群）に比し、避難所生活をしなかった被災群（B 群）、避難所生活をした被災群（C 群）とも大きく、かつ C 群は B 群に比し増悪度が大きかった。すなわち非被災者に比し被災者は、震災直後、認知機能、BPSD とも有意に増悪していることが明らかになり、かつその程度は避難所生活を強いられた患者に顕著であった（Furukawa et al. *Lancet* 2011, *J Neurol* 2012, *Geratr Gerontol Int* 2013）。また震災 12-15 か月後の MMSE および NPI-Q は、いずれの群においても数値の改善を認めたが、震災前のレベルには復帰していなかった。今回の大震災による被害の中心が東北地方の沿岸部であったこともあり、被災者の多くは高齢者であり、認知症患者も多く含まれている。避難所生活を強いられた認知症患者が精神的に混乱し、認知症症状の増悪をきたしたことは非常に残念な結果であった。我々は今後も厚生労働省の科学研究費補助金等を用いて震災後の高齢者の健康調査、復興に尽力していく所存である。

この論文は、平成 25 年 4 月 20 日（土）第 19 回中・四国老年期認知症研究会で発表された内容です。

RESEARCH STUDIES

Cognitive examination in older adults living in temporary apartments after the Great East Japan Earthquake

Dear Editor,

Northeast Japan experienced an earthquake of magnitude 9.0 in 2011, followed by enormous tsunamis. This seism destroyed coastal cities and killed nearly 20 000 people. After the disaster, many people who lost their houses were forced to live in temporary apartments with an area of just 5 m^2 per family. Our group recently recruited 686 older adults who lived in the temporary apartments in Kesennuma, Japan, and examined their cognitive functions using touch-panel computers[1] from February to May 2013. The participants were aged ≥66 years (male/female 235/451, mean age 76.4 ± 6.0 years). The program of using a touch-panel computer consisted of 15 questions that evaluate memory, orientation and pattern recognition. The full (best) score is 15, and scores of ≤12 are considered to be indicative of cognitive impairment according to Urakami *et al.*[1] The study was approved by the Tohoku University ethical committee. Figure 1 shows the score distribution, showing that 36.0% of older adults in this group scored ≤12. This result suggests that a significantly high percentage of older adults who live in the temporary apartments could be cognitively impaired, because 36.0% is much higher than the data in the previous reports using the same device in another area.[2,3] In addition, this 36% is also much higher than the prevalence of dementia reported in Japan, which is 14.1%.[4] Our group previously reported exacerbation of symptoms of Alzheimer's disease after the earthquake,[5,6] and the present study is the first to epidemiologically investigate the prevalence of dementia in older adults living in temporary residences. There are several reasons expected for the possibility of the high prevalence of dementia, which are as follows: (i) changes in living circumstances; (ii) loss of families, relatives and friends; (iii) loss of their daily activities, such as farming and fishing; and (iv) isolation from families and neighbors. Although it is not easy to resolve the problem, we are now planning some anti-dementia programs including exercise, diet, and management for lifestyle-related disorders to prevent development and progression of dementia.

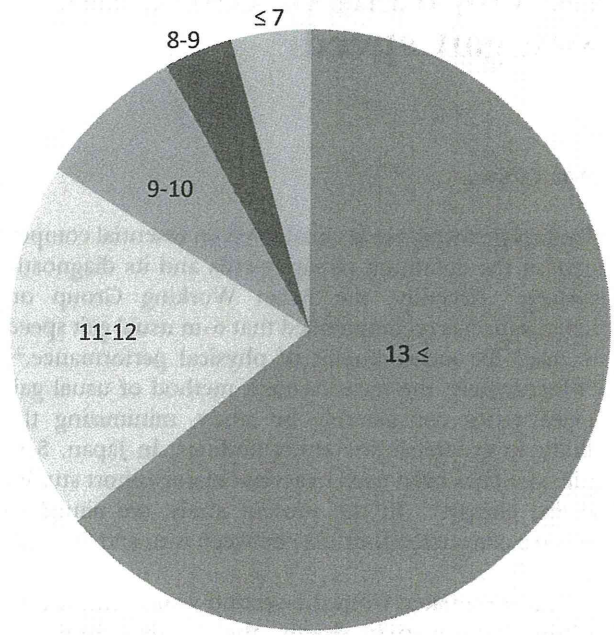

Figure 1 Score distribution of the touch-panel computer program to examine cognition. Scores of ≤12 are suspected to be indicative of cognitive impairment.

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Development of conversion formulae between 4-m, 5-m and 6-m gait speed

Dear Editor,

Physical performance is considered an essential component of the definition of sarcopenia and its diagnostic strategy.[1] Recently, the Asian Working Group on Sarcopenia has recommended that 6-m usual gait speed be used for measurement of physical performance.[2,3] Unfortunately, the measurement method of usual gait speed varies considerably by study, minimizing the ability to generalize the study findings. In Japan, 5-m gait speed has been used in several major cohort studies in the elderly.[4–6] In the present study, we aimed to develop conversion formulae between 6-m and 5-m gait speed.

Data were taken from the second year examinations of the Kashiwa study. Briefly, the Kashiwa study is a prospective cohort study on community-dwelling, functionally independent adults aged 65 years or older living in Kashiwa, Chiba, Japan, and the second year examination was conducted between September and November 2013.[5] All 1529 participants who underwent gait speed measurements were included in the analysis (782 men, 747 women). Gait speed measurements were conducted by instructing participants to walk over an 11-m straight course on a flat floor at their usual speed, during which the time was measured for both a 5-m walk (from 3-m to 8-m line) and 4-m walk (from the starting line to 4-m line) during one walk. Gait speed for both measurements was calculated in m/s. The correlation between these two measurements was 0.82.

The non-parametric locally weighted scatter plot smoothing (LOESS) method showed that the relationship between 4-m gait speed and 5-m gait speed was piecewise linear with an inflection point (change of slope) at a 5-m usual gait speed of 1.6 m/s. The piecewise linear model had better fit than a simple linear model, and the change of slope was statistically significant ($P < 0.001$). We also tested if the relationship between 4-m gait speed and 5-m gait speed was modified by sex, but the modification effect was not statistically significant ($P = 0.22$). All analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC, USA).

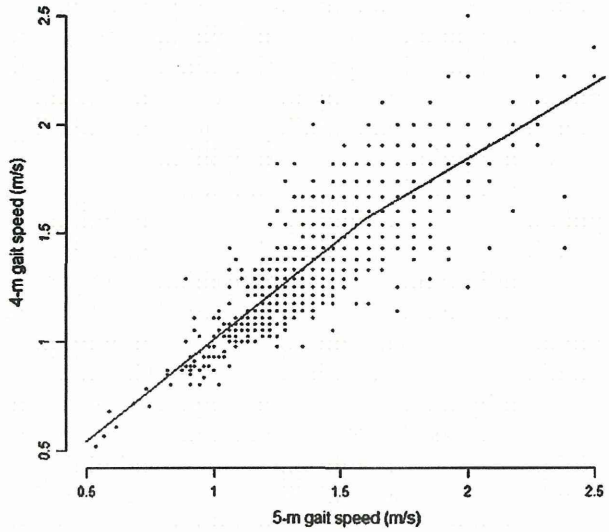

Figure 1 Scatter plot for 4-m gait speed and 5-m gait speed, and fitted piecewise linear relationship.

Participant characteristics (mean ± standard deviation) were: age 73.9 ± 5.5 years, 5-m gait speed 1.52 ± 0.25 m/s and 4-m gait speed 1.48 ± 0.26 m/s. Piecewise linear regression showed that the following equations could be used to convert from 5-m to 4-m gait speed:

For 5-m gait speed ≤1.6 m/s:

$$\text{4-m gait speed} = 0.934 \times (\text{5-m gait speed}) + 0.074$$

For 5-m gait speed >1.6 m/s:

$$\text{4-m gait speed} = 0.69 \times (\text{5-m gait speed}) + 0.463$$

The scatter plot of 4-m and 5-m gait speed, and their piecewise linear relationship are shown in Figure 1. The $R^2 = 0.68$.

To convert to 6-m gait speed, we substituted the aforementioned equations for 4-m gait speed in the formula with the R^2 of 0.93 from a previous study on a

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ORIGINAL RESEARCH

Health Effects of a Farming Program to Foster Community Social Capital of a Temporary Housing Complex of the 2011 Great East Japan Earthquake

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ABSTRACT

Objective: We launched a health promotion program called the *Hamarassen* ("let's get together") Farm, which provided farming opportunities for the victims of the Great East Japan Earthquake who resided in temporary housing. The aim of this study was to evaluate the effects of this program on physical and mental health in terms of bone mineral density (BMD) and a sense of purpose in life.

Methods: Among 39 female participants in whom BMD was evaluated, there were 12 Hamarassen participants, 8 self-farming control subjects, and 19 non-farming control subjects. BMD was measured by calcaneal quantitative ultrasound immediately after the project launch and 5 months later. A sense of purpose in life prior to and 2 months after the project's commencement was measured in 21 additional Hamarassen participants by use of the K-I Scale. Interviews were also conducted to qualitatively evaluate the effects of the Hamarassen program.

Results: The mean BMD T-score improved by 0.43 in the Hamarassen group, by 0.33 in the self-farming group, and by 0.06 in the controls ($p = 0.02$). Among the 21 Hamarassen participants in whom mental health was evaluated, the average score for a sense of purpose in life improved from 20.5 to 24.9 ($p = 0.001$).

Conclusions: The Hamarassen Farm provided disaster victims with opportunities for social participation, interpersonal interaction, and physical exercise; such opportunities may improve physical and psychosocial well-being. (*Disaster Med Public Health Preparedness.* 2015;0:1-8)

Key words: preventive health services, public health practice, earthquakes

The Great East Japan Earthquake occurred on March 11, 2011, and caused a massive tsunami with a maximum wave height of 40.1 m, which affected over 500 km of Japan's northeastern coastal areas. As of December 2013, over 300,000 victims were reported as still living in temporary housing provided by the Japanese government for those who lost their homes as a result of the tsunami. The city of Rikuzentakata, examined in the present study, was one of the areas most seriously affected by the disaster. Of its total population of 23,302 before the disaster, 1773 people died or are still missing. Of 8550 households, 3368 were affected, and 13,474 people in 3159 households had to move to temporary housing within 3 months of the tsunami.[1] Many of the people who were obliged to move to temporary housing were older adults. The average age of the city's population was high before the disaster occurred: in 2010, individuals older than 65 years accounted for 34.9% of the total population.[2]

Depression and mental illness among victims have been identified as a central issue in major disasters.[3] The Great East Japan Earthquake was no exception, and mental health care has become a basic aid activity in victim support. After the earthquake, it was widely observed that older residents in temporary housing suffered from multiple physical and mental burdens that were attributable not only to the disaster itself but also to the loss of the communities to which the residents originally belonged.[4,5] Such individuals have shown the tendency to be sedentary and to suffer from high stress owing to the loss of their social roles and the opportunity to participate in community life, and these stresses are compounded by coping with the new living environment of small rooms in the temporary housing.[6] The weakened physical, cognitive, and mental functioning of older adults following loss of social participation has been observed in connection with previous large-scale disasters in Japan and is known as "disuse syndrome."[7] Although agriculture is

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the primary industry in the study area, many individuals after the disaster were unable to engage in farm work because they had lost their land, were unable to access the land owing to a lack of transport, or did not own any land even if they wished to undertake farm work.

To prevent the development of disuse syndrome by providing opportunities for social participation and physical activities for older residents in temporary housing in Rikuzentakata, Iwate Prefectural Takata Hospital in 2012 launched a farming project called *Hamarassen* ("let's get together") Farm. In theory, social participation may not only improve physical and mental health but also increase community social capital, i.e., as Putnam defined, "the collective value of all 'social networks' and the inclinations that arise from these networks to do things for each other." Empirical evidence also suggests that social capital may play an important role in disaster resilience.[8-10] Therefore, the objectives of this study were to evaluate the effect of the Hamarassen Farm project on physical and mental health in terms of differences in changes in bone mineral density (BMD) between participants and nonparticipants and changes in the sense of purpose in life of the Hamarassen participants over a 5-month period. We also qualitatively evaluated narrative comments provided by the Hamarassen participants to consider the potential mechanisms of the effects of Hamarassen Farm on physical and mental health.

METHODS

Hamarassen Farm

Regardless of age, gender, or experience, all residents in temporary housing in Rikuzentakata were eligible to participate in the Hamarassen Farm project. All leaders of the self-governing bodies of 50 temporary housing complexes in Rikuzentakata were asked to take part in this project. Of those leaders, 41 replied and 11 expressed interest in participation (another 11 were already involved in community farmland projects). In establishing the Hamarassen Farm, from May to August 2012, members of the project team of Iwate Prefectural Takata Hospital looked for fallow farmland adjacent to or within 5 minutes' walk of the participating temporary housing complexes. Appropriate pieces of farmland were found and negotiation for leasing took place with the landowners. Only free farmland was leased (the landowners received no rent or financial reward). Eventually, 11 farms were set up. Landowners or local residents were asked to help cultivate the farmland (if necessary, hospital workers also cultivated it), and the cultivated farmland was handed over to the study participants. The participants provided their own seeds, seedlings, farming tools, and equipment and they developed their own farming plans (Figure 1).

Recruitment of Hamarassen Participants

In June 2012, 12 female Hamarassen participants were recruited who were residing in 3 temporary housing complexes that were built shortly after the earthquake and their BMD was measured (Hamarassen group). At the same time, health-promotion seminars for the general population in Rikuzentakata were carried out, and volunteers who were willing to have their BMD measured were recruited. Five months later, the BMD of 19 women who were not engaged in farming activities and 8 women who grew vegetables on their own farms or in their own kitchen gardens were measured; the data of the former were used for the nonparticipating group and those of the latter were used as the self-farming group. For all 3 groups, BMD was measured in June and November 2012. None of the participants received any osteoporosis treatment before or during the project.

As of December 2013, the Hamarassen project was ongoing at 11 locations. There were approximately 80 participants, with the male:female ratio being 1:8. The age range of the participants was from 30 to 95 years, with the median age being 70. Approximately 40% of the participants had no experience with farming. Only female Hamarassen participants participated in our BMD evaluation.

To evaluate the changes in the Hamarassen participants' psychosocial well-being, the sense of purpose in life (subjective attitude toward living significantly) among an additional 21 participants in 3 Hamarassen farms was measured before the beginning of farming in June and August 2012. Purpose in life was measured only in the Hamarassen group.

Measurement of BMD

Bone densitometry was performed by using quantitative ultrasound methods of the heel bone (GE Healthcare Japan) at the launching of the project at the health lectures in June 2012 and 5 months later in November 2012. The calcaneus is a widely used measuring spot for BMD by quantitative ultrasound. The device used requires the application of alcohol or gel to the foot, after which the foot can be placed in the device for measurement, which takes up to 30 s. The calcaneus of the left foot was measured to assess the lowest value of BMD. T-score-derived variables were used for the evaluation.

Evaluation of the Sense of Purpose in Life

The K-I Scale was included in our self-administered questionnaire survey and the Feeling That Life is Worth Living Among the Aged, a validated psychometric scale designed for older adults in Japan,[11] was used for the surveys. This scale was constructed through the investigation of the notion of purpose in life and has been verified to have high reliability and validity. The scale quantifies the sense of having purpose in life by means of questions on a sense of fulfillment, a desire to improve oneself, motivation, and a sense of being. Participants were also asked retrospectively about their sense of purpose before becoming involved in the farm project. The K-1 Scale consists of four factors: (1) self-actualization and motivation (challenging spirit with purpose and motivation toward everything),

FIGURE 1

Participants of the Hamarassen Farm Project in Rikuzentakata, Japan.

(2) satisfaction with life (challenging spirit with self-awareness of making a contribution to others), (3) motivation to live (sense of self-progression), and (4) sense of existence (sense of being approved of by others). There are a total of 16 questions. Each question was scored by using the following scale: (1) agree (2 points), (2) neither agree nor disagree (1 point), and (3) disagree (0 points). The total score was calculated, with 32 points signifying a perfect score. To assess the change in responses before and after the intervention, an additional evaluation using narrative interviews with open-ended questions was performed. Further, to assess the quality of having been involved in the farm project, participants were given an opportunity to provide free comments 5 months after having commenced the farm work.

Statistical Analyses

Changes in BMD among the 3 groups were analyzed with a difference-in-difference estimator, employing generalized estimating equations under the assumption of normal distribution of the BMD parameter. For comparability across groups, the T-score, standardized for average, and standard deviations were used. This approach can formally control the effects of confounding factors. For confounding factors, age, baseline BMD T-score, and residential temporary housing complex were considered. Changes in purpose in life within Hamarassen participants were modeled by using a generalized estimating equation to address within-individual clustering. One subject was omitted whose age information was not provided. All analyses were conducted by using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

Ethical Considerations

Participants gave their oral consent to have a physical examination including measuring BMD and brief medical interviews. This research was approved by the Iwate Prefectural Takata Hospital Ethical Committee.

TABLE 1

Characteristics of the Female Participants in Whom Bone Mineral Density Was Evaluated

	Hamarassen Farm Group	Self-Farming Group	Nonparticipating Control Group	Total
Number of participants, n	12	8	19	39
Age, y, mean (SE)	74.3 (5.6)	73.5 (6.9)	81.1 (6.3)	77.4 (7.1)
Residential temporary housing complex, n (%)				
Complex H	0 (0)	4 (50)	10 (52.6)	14 (35.9)
Complex M	0 (0)	4 (50)	0 (0)	4 (10.3)
Complex S	7 (58.3)	0 (0)	1 (5.3)	8 (20.5)
Complex Ta	1 (8.3)	0 (0)	2 (10.5)	3 (7.7)
Complex Te	0 (0)	0 (0)	5 (26.3)	5 (12.8)
Complex Y	4 (33.3)	0 (0)	0 (0)	4 (10.3)
Complex U	0 (0)	0 (0)	1 (5.26)	1, (2.6)
Bone mineral density T-score, mean (SE)				
Baseline	−2.76 (0.78)	−2.51 (1.09)	−3.33 (0.76)	−2.99 (0.89)
Follow-up	−2.33 (0.9)	−2.19 (1.12)	−3.33 (0.61)	−2.76 (0.95)
Difference	0.43 (0.46)	0.33 (0.47)	0.06 (0.34)	0.23 (0.43)
P value	0.009	0.09	0.4	0.002

RESULTS

Changes in BMD

The individuals in whom BMD was evaluated were all women. Those in the Hamarassen group and the self-farming group were younger than the nonparticipants: the participants' mean ages were 74.3 (SD = 5.6), 73.5 (SD = 6.9), and 81.1 years (SD = 6.3) in the Hamarassen group, self-farming group, and control group, respectively (Table 1). The mean BMD was also high in the Hamarassen and self-farming groups. The change in BMD T-scores in the Hamarassen group was 0.43 (standard error [SE], 0.46; $P = 0.009$); that in the self-farming group was 0.33 (SE, 0.47; $P = 0.09$) and that in non-participating subjects was 0.06 (SE, 0.34; $P = 0.43$).

The GEE-based difference-in-difference models showed that even with adjustment for baseline BMD, age, and residential temporary housing complex, the differences in the changes in BMD T-score compared with the control group were 0.36% (95% confidence interval: 0.07 to 0.66) for the Hamarassen group and 0.26 (95% confidence interval: −0.08 to 0.60) for the self-farming group (Table 2).

TABLE 2

Differences in the Change in Bone Mineral Density T-score: Results of Difference-Indifference Models With Generalized Estimating Equations[a]

	Estimates	95% Confidence Intervals		*P* value
Intercept	−1.99	−5.36	1.38	0.2
Hamarassen Farm Group	−0.69	−1.3	−0.04	0.04
Self-Farming Group	−0.048	−1	0.95	0.9
Nonparticipating Group	Referent			.
Time (follow-up vs. baseline)	0.063	−0.09	0.21	0.4
Time × Hamarassen	0.36	0.07	0.66	0.02
Time × Self-Farming	0.26	−0.08	0.61	0.1
Time × Nonparticipating	Referent			.
Age	−0.0045	−0.05	0.037	0.8

[a]Fixed effects of residential temporary housing complex (7 complexes) were adjusted for.

Changes in Purpose-in-Life Score

At baseline, the total score was 20.5 (SD, 9.0) on average, and that score increased to 24.9 (SD, 6.4) after 2 months of participation ($P = 0.005$; Table 3 and Figure 2). The GEE models revealed that even after adjustment for age, sex, and residential temporary housing area, the total score and 3 of the 4 components of the K-1 system increased over time after involvement in the Hamarassen project. The total score rose by 5.46 points ($P = 0.0004$), and there were increases in self-actualization and motivation (1.81, $P = 0.01$), satisfaction with life (2.42, $P = 0.0002$), and motivation to live (0.73, $P = 0.01$. However, there was no large increase in sense of existence (0.51, $p = 0.14$) (Table 4). Because the K-1 system was originally designed for application among subjects aged 60 years or older, a sensitivity analysis using only 16 participants aged 60 and above was conducted. However, the results were the same as in the original analyses, with only very small differences appearing in the estimated values.

Most of the free comments about the Hamarassen project provided by the participants were positive, and they signaled happiness and enjoyment related to the scheme (Table 5). The participants' positive feelings were related to the development of new, continuous interpersonal connections with other participants and the acquisition of emotional social support through those communications.