Table 3. Standard incidence ratio of cerebrovascular diseases corrected by those of the control areas around the Great East Japan Earthquake and Tsunami of 2011 according to the grade of flooding damage by the tsunami.

Subgroup	Flooding damage	Pre-disaster		Disaster			Post-disaster		
		SIR	95% CI	SIR	95% CI		SIR	95% CI	
Men									
	Low flood areas	1.00	(Ref)	1.08	(0.98 - 1.18)		1.04	(0.93 - 1.15)	
	High flood areas	1.00	(Ref)	1.07	(0.93 - 1.21)		0.90	(0.76 - 1.03)	
Women									
	Low flood areas	1.00	(Ref)	1.03	(0.92 - 1.13)		1.17	(1.05 - 1.30)	*
	High flood areas	1.00	(Ref)	1.10	(0.94 - 1.25)		1.42	(1.22 - 1.62)	*
Aged<75 years									
	Low flood areas	1.00	(Ref)	1.11	(0.92 - 1.13)		1.12	(0.99 - 1.25)	
	High flood areas	1.00	(Ref)	0.95	(0.94 - 1.25)		1.09	(0.92 - 1.26)	
Aged ≥75 years									
	Low flood areas	1.00	(Ref)	1.05	(0.95 - 1.14)		1.10	(0.99 - 1.20)	
	High flood areas	1.00	(Ref)	1.24	(1.09 - 1.40)	*	1.16	(0.99 - 1.32)	
Men < 75years									
	Low flood areas	1.00	(Ref)	0.92	(0.79 - 1.04)		0.95	(0.81 - 1.09)	
	High flood areas	1.00	(Ref)	1.02	(0.84 - 1.20)		0.97	(0.78 - 1.16)	
Men ≥75 years									
	Low flood areas	1.00	(Ref)	0.94	(0.80 - 1.07)		0.97	(0.83 - 1.12)	
	High flood areas	1.00	(Ref)	1.15	(0.93 - 1.37)		0.81	(0.61 - 0.99)	*
Women < 75years									
	Low flood areas	1.00	(Ref)	1.08	(0.89 - 1.28)		1.30	(1.05 - 1.56)	*
	High flood areas	1.00	(Ref)	0.78	(0.56 - 1.01)		1.41	(1.06 - 1.76)	*
Women ≥75 years									
	Low flood areas	1.00	(Ref)	1.01	(0.89 - 1.14)		1.14	(0.99 - 1.29)	
	High flood areas	1.00	(Ref)	1.29	(1.07 - 1.50)	*	1.47	(1.22 - 1.73)	*

Pre-disaster: the period three years before the disaster between March 11, 2008 and March 10, 2011.

Disaster: the first year after the disaster between March 11, 2011 and March 10, 2012.

Post-disaster: the second year after the disaster between March 11, 2012 and March 10, 2013.

SIR: standard incidence ratio adjusted by the incidence of pre-disaster year

CI: confidence intervals

*: $p<0.05$

厚生労働科学研究費補助金（健康安全・危機管理対策総合研究事業）
分担研究報告書

東日本大震災による岩手県における被災者コホートでの血中B型ナトリウム利尿ペプチド前駆体N端フラグメント濃度の検討

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研究要旨
大自然災害後には心不全等の循環器疾患の罹患率が増加することが報告されている。しかし、心機能マーカである血中B型ナトリウム利尿ペプチド前駆体N端フラグメント(NT-proBNP)濃度が被災住民で上昇しているかどうかは明らかではない。本研究では、岩手県南沿岸地域の一般住民10,167名を対象に東日本大地震津波災害（平均8ヵ月）後に血中NT-proBNP濃度および各種健康指標や災害被害程度を調査し、その関連性を検討した。全体では血中NT-proBNP値は高年齢ほど高く、女性でより高い傾向があった。また、同値は心電図、血清アルブミン、肺活量、糸球体ろ過率の異常例で高い傾向があった。しかし、被災程度の大小により明らかな差異は認めなかった。以上より、血中NT-proBNP値は心機能、栄養状態、肺機能、腎機能の低下で上昇するが発災後約半年を経過した時点では災害被害により明らかな影響を受けているとは考えにくい。

A．研究目的

本研究の目的は、平成23年度に研究に同意した本コホートにおいて心機能マーカである血中B型ナトリウム利尿ペプチド前駆体N端フラグメント(NT-proBNP)を測定し、対象者の臨床的特徴や被災状況との関連を明らかにすることである。

B．研究方法

本研究の対象者は、東日本大震災で甚大な被害を受けた岩手県大槌町、陸前高田市、山田町、釜石市平田地区の一般住民で、18歳以上の全住民に健診の案内を郵送し、平成23年度に健診会場にて研究参加と血中NT-proBNP測定の同意を得た10,167名である。

その他の健康調査の項目は、身長、体重、腹囲、握力、血圧、眼底、心電図（40歳以上のみ）、血液検査、尿検査、呼吸機能検査である。以上は発災日(2011年3月11日)から平均236(範囲178-328)日後に実施された。

また、発災後約3年を経た時点で災害後の転居回数、暮らし向き（経済的な状況）、災害時の家屋の被害状況などのアンケート調査を実施した。

C．研究結果と考案

1．対象者の特徴

性、年代別の対象者の分布を図1に示した。60歳代、70歳代が多数を占め、10歳代と90歳代は男女とも各々10-20名のみであった。また、男女別で見ると女性

が全体の61%、男性が39%であり、女性が男性の1.56倍であった(図2)。

2. 血中NT-proBNP

20歳代から80歳代の10,115名の性・年代別の中央値を図3に示した。年齢が高くなるにつれて高くなり、各年代ともに男性に比較し女性で高い値を示す傾向があった。

3. 血中NT-proBNPの基準値について

本コホートにおいて高血圧(含む治療)、糖尿病（含む治療）、肥満(BMI30), ECG異常、高Cr血症（1.2以上）、腎臓病既往、息切れ、胸痛、胸締付感、脈の乱れ、心血管疾患既往既往、貧血、がん既往の全てが無しを満たす40歳から89歳の受診者(n = 2,478)を対象に血中NT-proBNPの基準値(90パーセンタイル値)を男女、年代別に求めた（図4）。

年齢に上がるにつれてその基準値は上昇し、60歳代では男性95、女性110、70歳代では男性130、女性150でっあった。80歳代では男性300、女性200と男性の方が高値であった。

4. 各臨床指標との関連

全体での血中NT-proBNP値と年齢、収縮期血圧、血清クレアチニン値との間には有意な正相関関係がみられた。また、同値とBMI、ヘモグロビン値、血清アルブミン値(図5左)、肺活量(図5右)との間には負の相関関係がみられた。

また、血中NT-proBNP値と腎機能との比較をすると血清クレアチニン値との間に正の相関関係がみられ（図6左）、また、推算GFR(EPI式)と間には有意な負の相関関係がみられた（図6右)

心電図異常との関連を見ると、判定の異常なし(a)、経過観察(b)、要精査(c)の順に従い値が高くなった(p < 0.001; 図7)。

5. 心血管リスク因子との関連

心血管リスクの有無と血中NT-proBNP値の関連を検討した。年齢と性別を調整因子として高血圧（治療中を含む）、糖尿病（治療中を含む）、肥満（BMI30）、現喫煙、高コレステロール血症（治療中を含む）の有無で血中NT-proBNP値の差異がないかどうかを検討した。その結果、同値は高血圧、糖尿病は有り群が無し群に比較して高値であった(p<0.01:図8)。肥満群(BMI>=30)では非肥満群に比較し同値は低かった(p < 0.01)。現喫煙群では非現喫煙に比べNT-proBNP値は高い傾向があった(p = 0.093)。また、高コレステロール血症群では非高コレステロール血症群に比較し同値は有意に低値であった(p < 0.001)。

6. 被災の程度と血中NT-proBNP値

災害による各種の被害状況の程度と血中NT-proBNP値（非調整）の関連を検討した。被災の程度は1)被災時の自宅の損壊程度（半壊以上vs半壊未満）。2)災害時の同居者死亡(ありvsなし)。3)災害3年後までの転居回数(2回以上vs未満)。4)災害3年後の自宅以外の居住（自宅vs自宅以外）。以上の4項目の有無に関して血中NT- proBNP値を比較した。いずれの被災の程度の有無で有意な血中NT-proBNP濃度の差異は認めなかった(図9,図10)。

D. 結論

血中NT-proBNP値は心機能、栄養状態、肺機能、腎機能の異常で上昇するが発災後約半年経過した時点では災害被害により明らかな影響を受けているとは考えにくい。

E．倫理面への配慮

本研究では、被災者の個人情報を含むデータを扱う。データの使用にあたっては、被災者本人に対して、研究の目的・方法等の趣旨、及び個人情報が公表されることがないことを明記した文書を提示し、口頭で説明した上で文書にてインフォームドコンセントを得ている。また、同意者には同意の撤回書を配布し、同意の撤回はいつでも可能であり、撤回しても不利益を受けない旨を伝えている。

本調査によって得られた個人情報は、岩手医科大学衛生学公衆衛生学講座の常時電子施錠しているデータ管理室と被災者健診のために新たに設置した情報管理室に厳重に管理している。データ管理室と情報管理室は許可された者以外の出入りが禁止されている。出入りはIDカードによって施錠管理されている。電子化された情報は情報管理室のネットワークに接続されていないパソコンで管理されている。解析には個人情報を削除したデータセットを用いる。

F．研究発表

1．論文発表
作成中

2．学会発表
第63回日本心臓病学会（横浜）
（2016年9月予定）

G．知的財産権の出願・登録状況

1．特許取得
特になし
2．実用新案登録
特になし
3．その他
特になし

対象者の性・年代別分布
(n = 10,167)

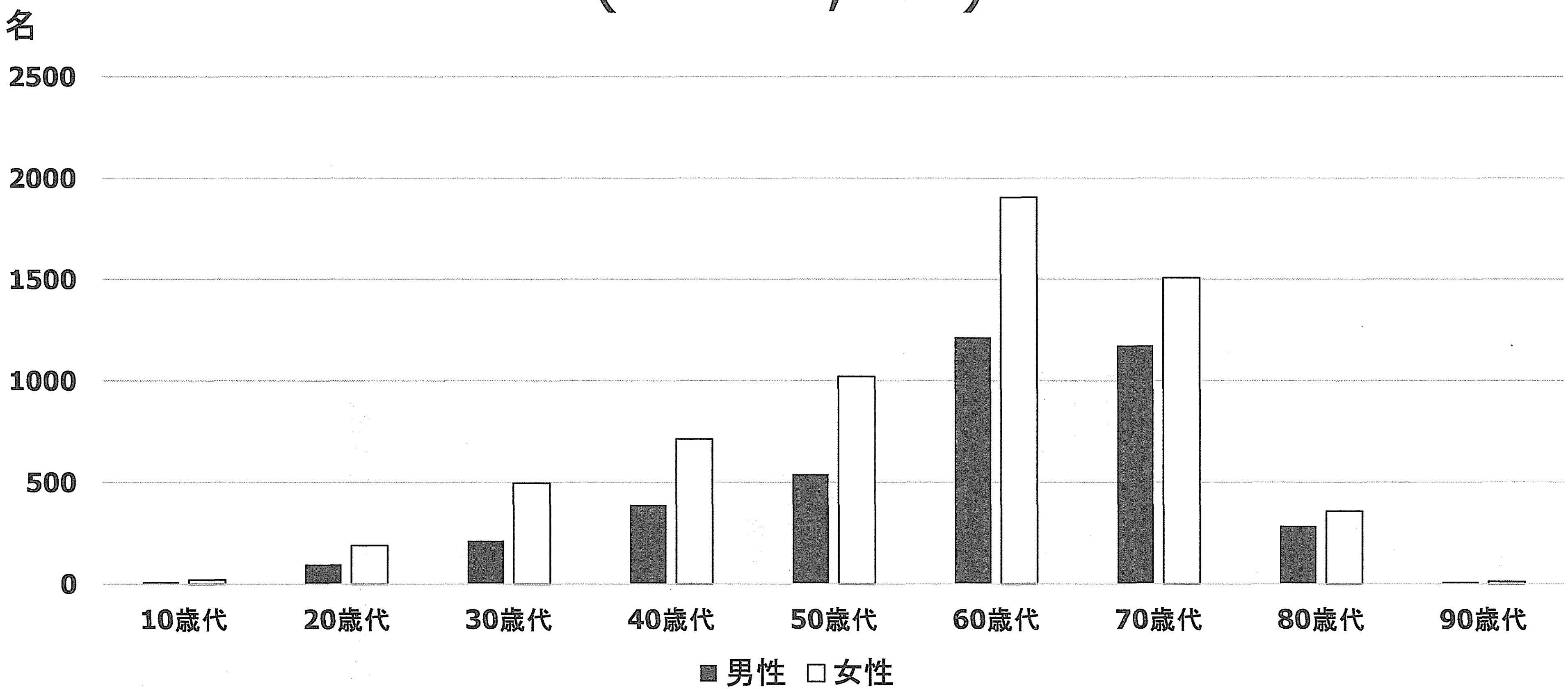
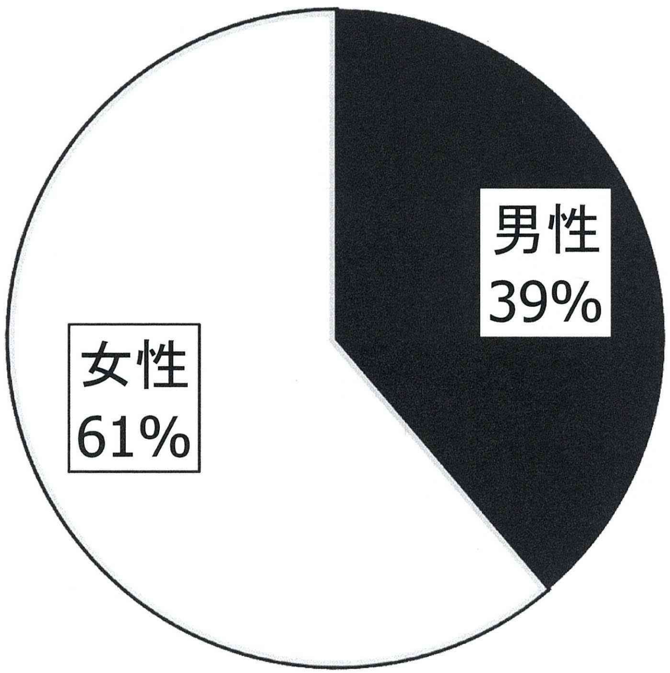


図1

対象者の性別・年代別分布
(n = 10,167)



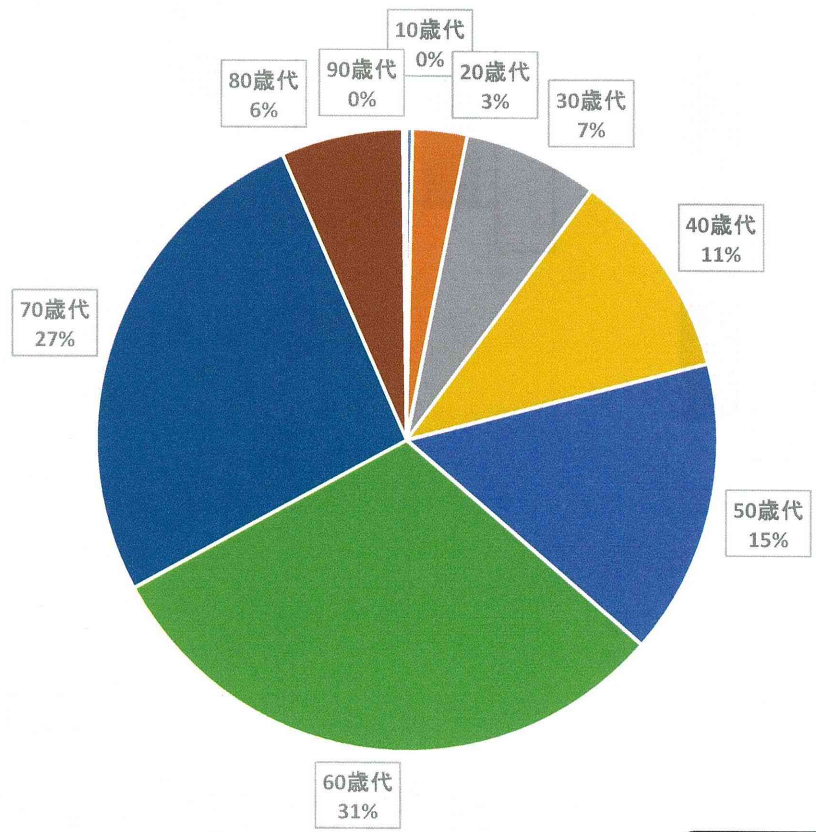


図2

NT-proBNPの性・年代別の中央値
(n = 10,115)

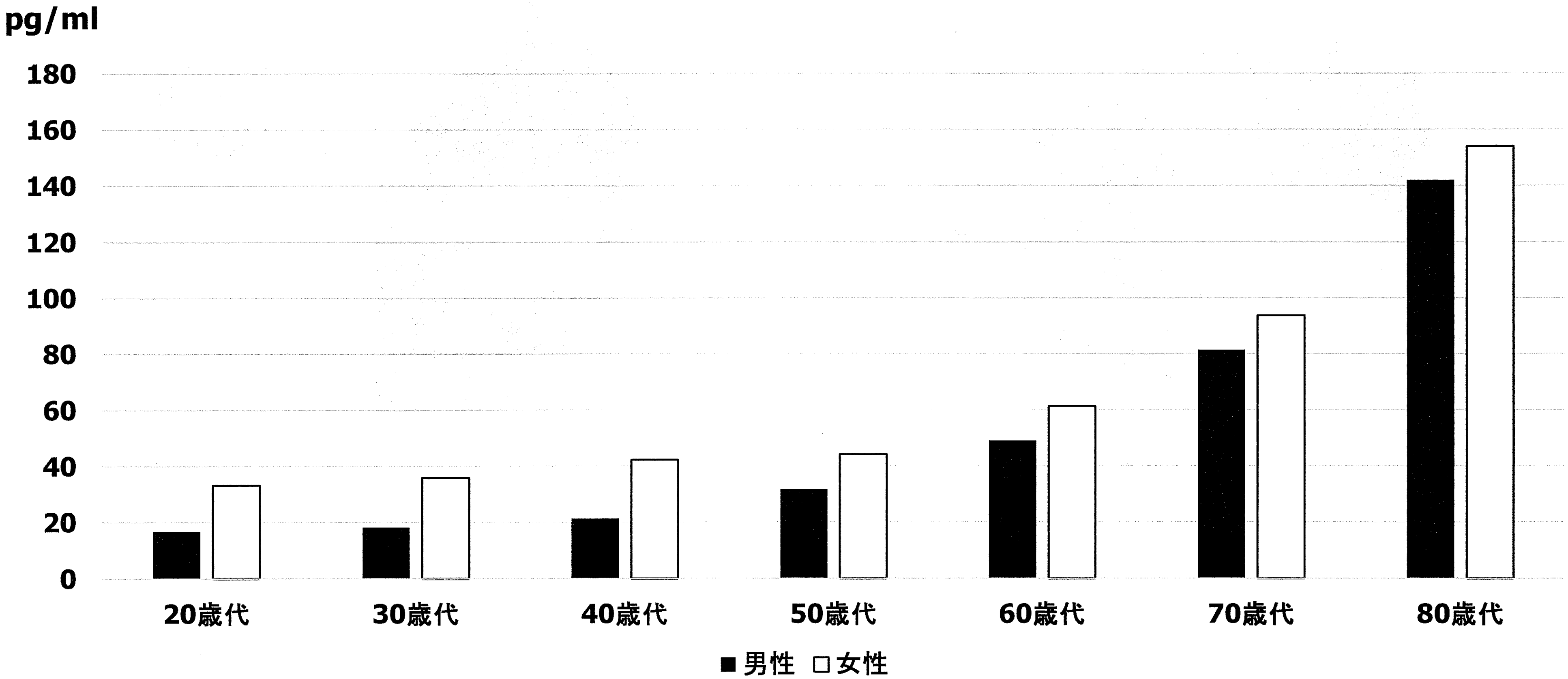


図3

NT-proBNPの基準値

正常者の90パ-センタイル値

(n = 2,478)

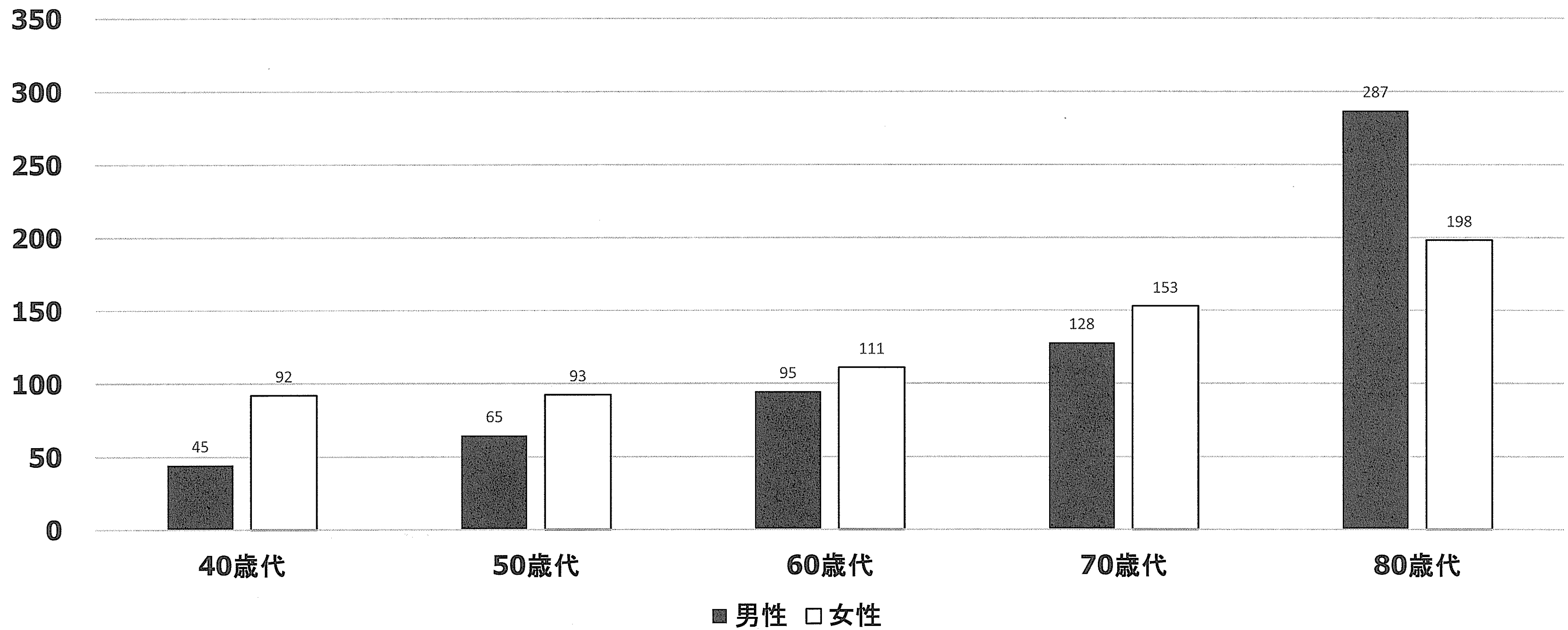
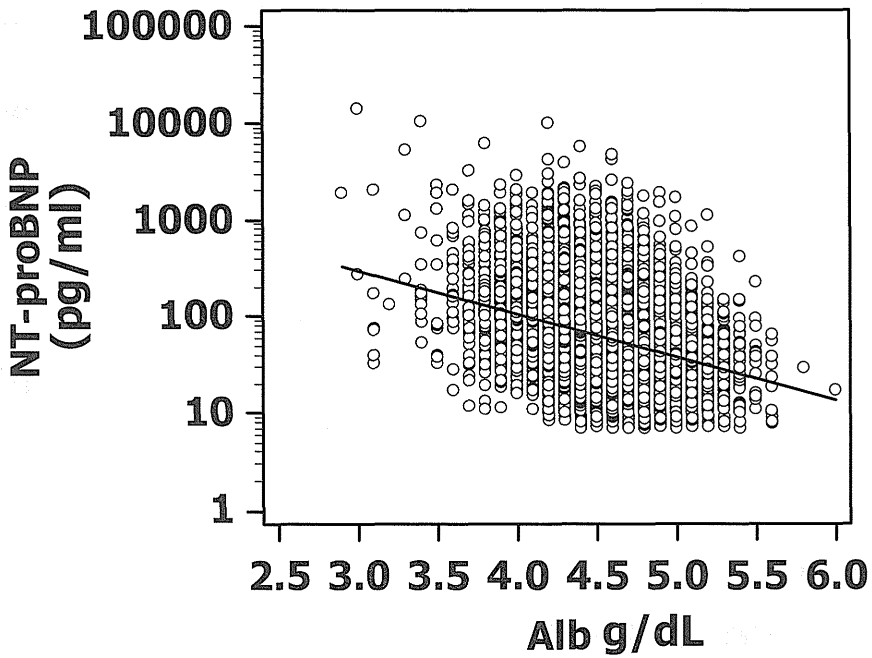


図4

NT-proBNP値と血清アルブミン値(左)および肺活量(右)との逆相関関係



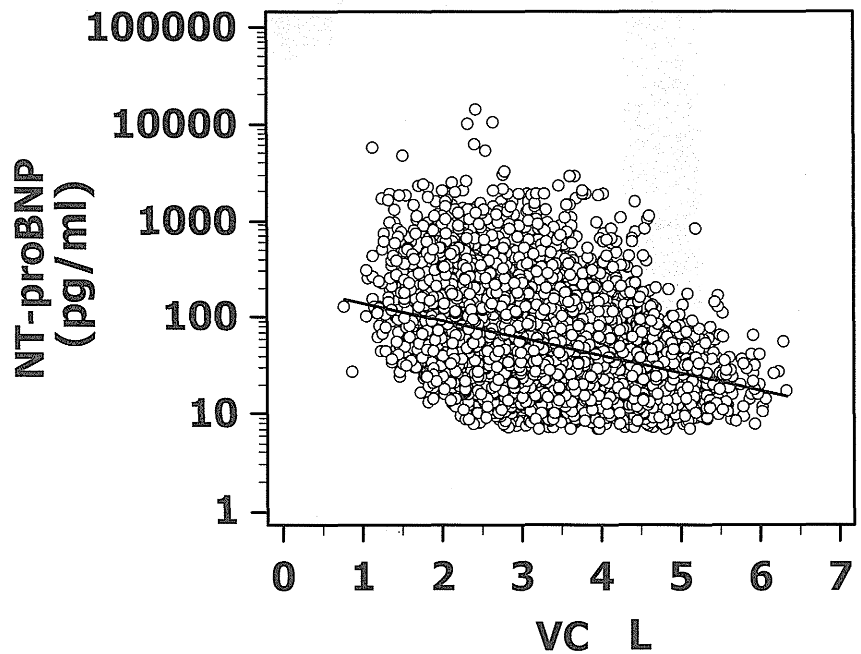


図5

NT-proBNP値と血清クレアチニン値(左)および推算GFR(右)との逆相関関係

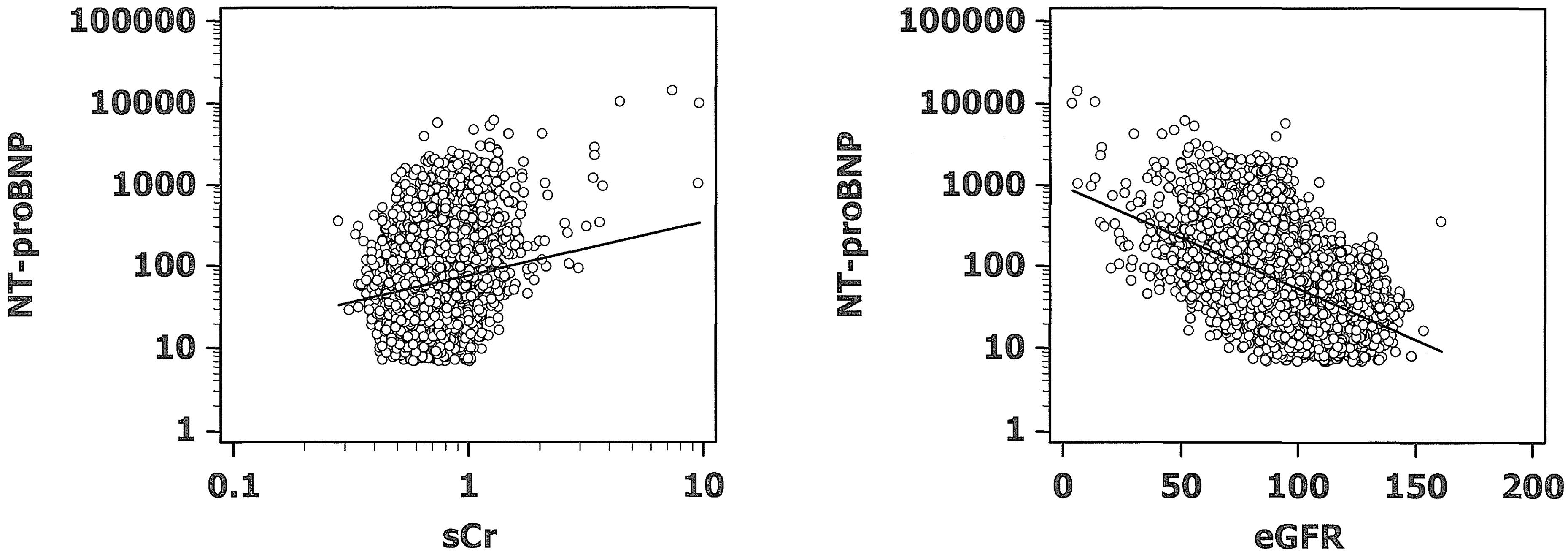


図6

心電図所見とNT-proBNP値

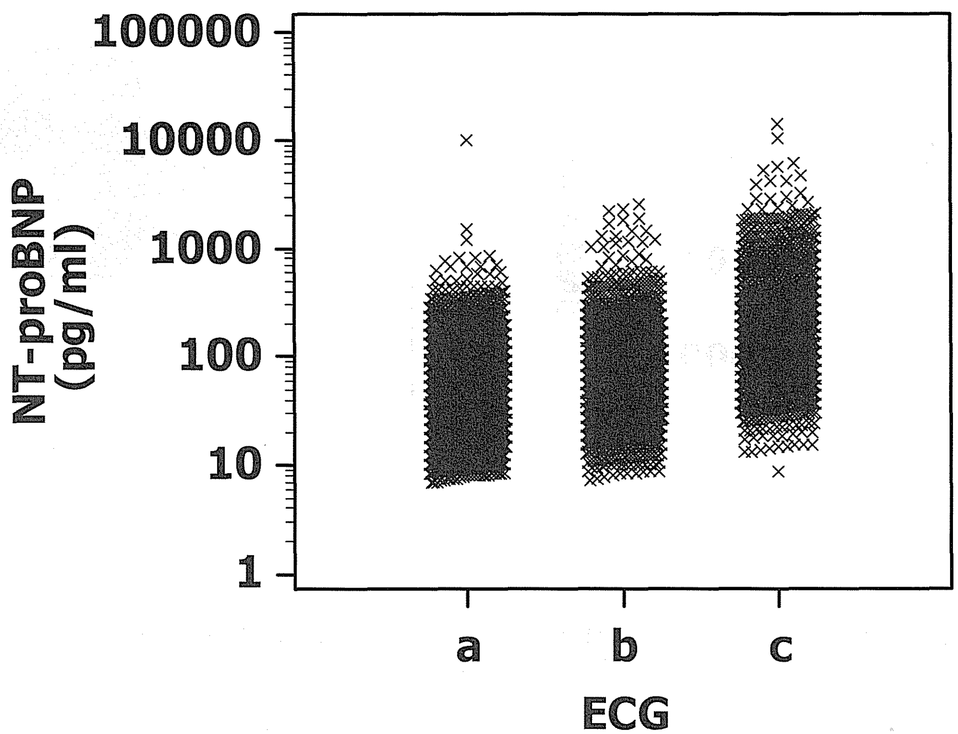
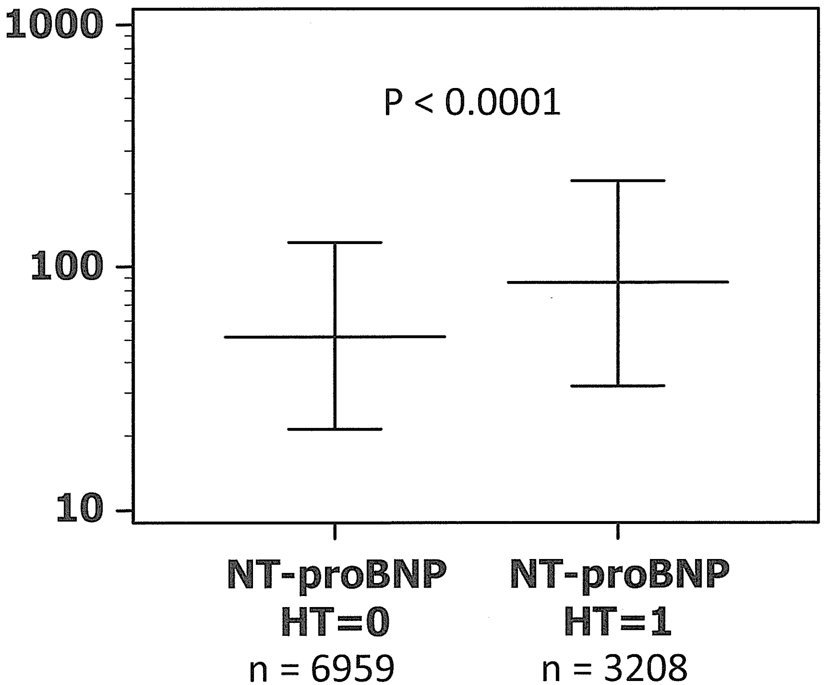


図7

高血圧(左)および糖尿病(右)の有無とNT-proBNP値(平均±SD)



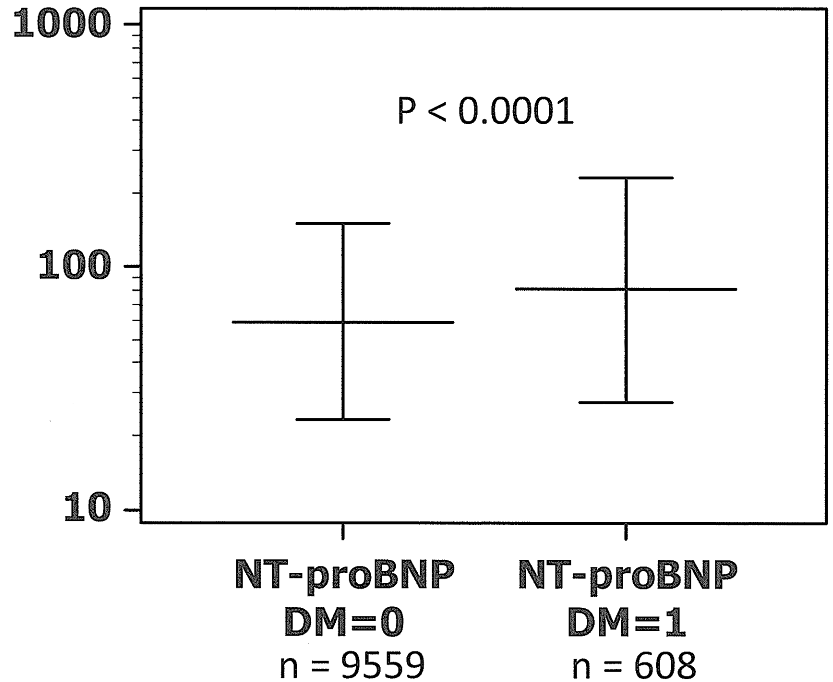


図8

住宅全半壊(左)および同居者死亡(右)の有無とNT-proBNP値(平均±SD)

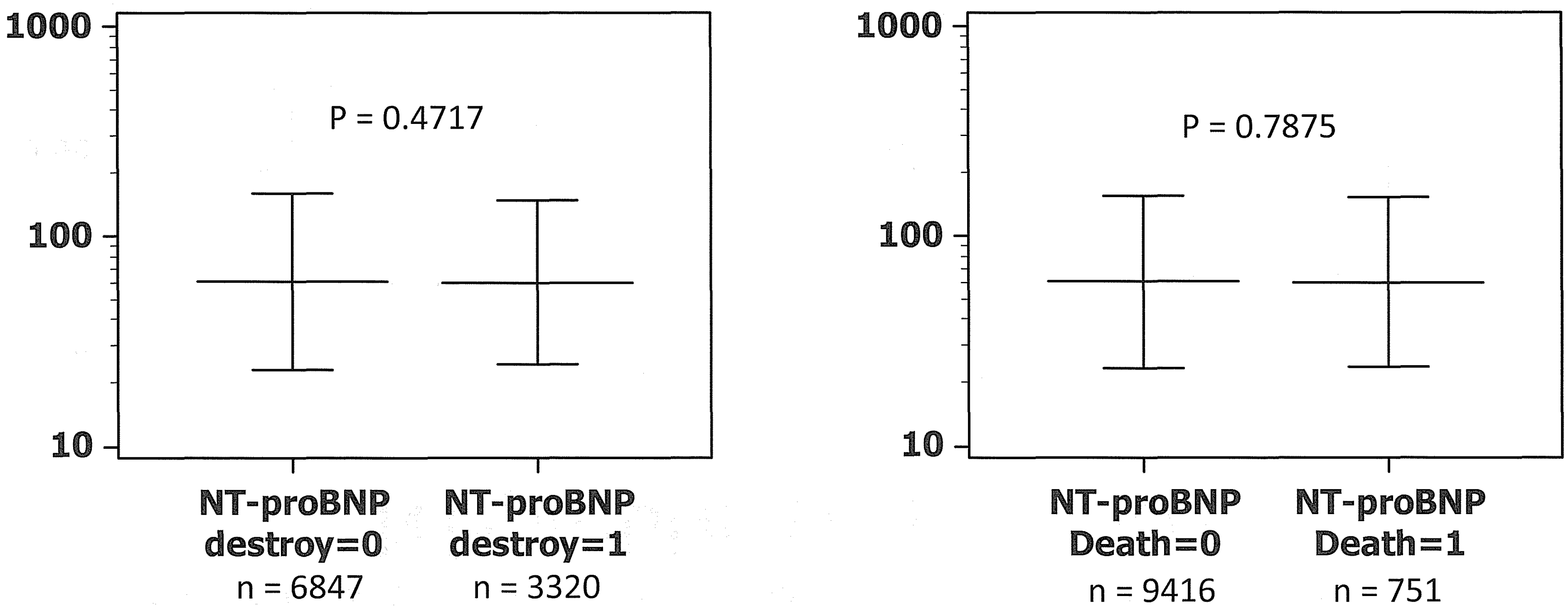


図9

転居回数(左)および住居状態(右)と NT-proBNP値(平均±SD)

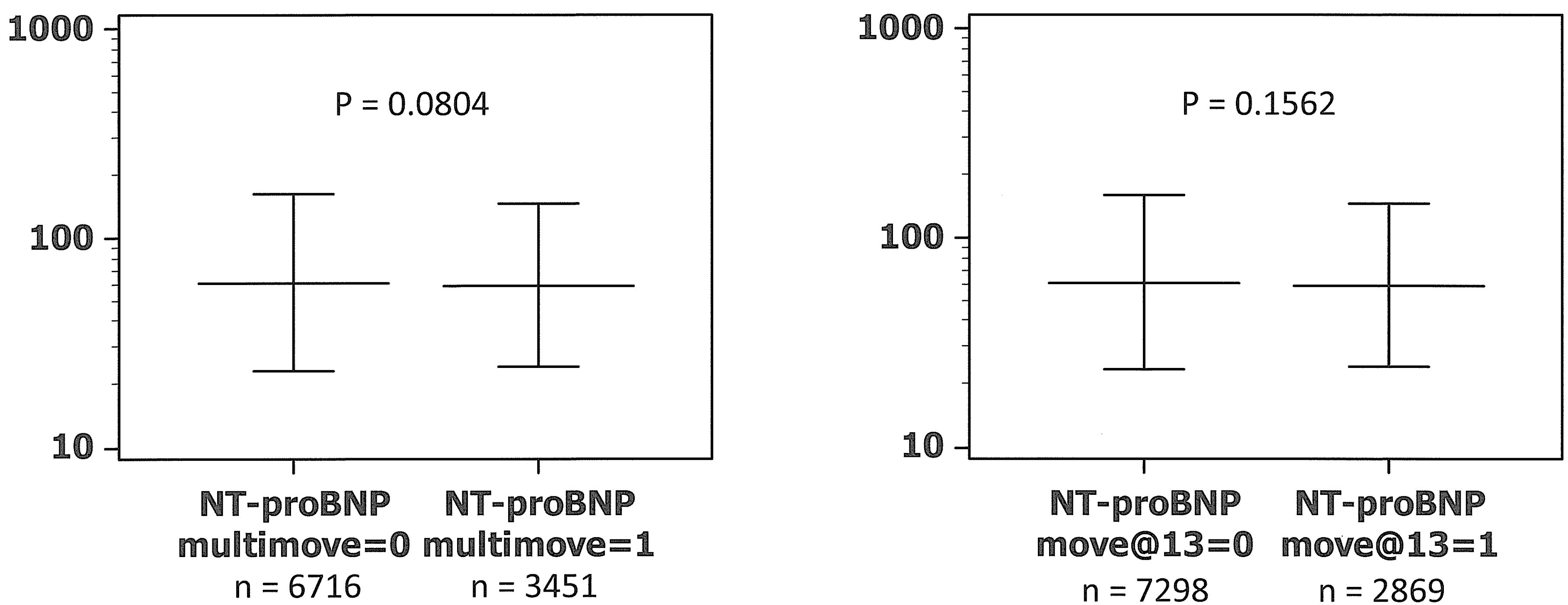


図10

厚生労働科学研究費補助金（健康安全・危機管理対策総合研究事業）
分担研究報告書

東日本大震災津波災害後の急性心筋梗塞の発症増加に関する研究

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研究分担者　中村 元行（岩手医科大学 医学部内科学講座心血管・腎・内分泌内科分野教授）

研究要旨：**Background:** Previous studies have reported a relationship between large earthquakes and acute coronary events, but have yielded conflicting results. The aim of this study is to clarify the influence of the 2011Northeast Japan earthquake and tsunami the risk of acute myocardial infarction (AMI) including sudden cardiac death on the basis of data from a population based analysis. **Methods:** The study subject was residents in the northeast of Iwate prefecture, Japan. Cases corresponding to the definition of AMI according to the criteria of the World Health Organization MONICA project were registered from four weeks before to eight weeks after the disaster and in the corresponding periods in 2009 and 2010. **Results:** The relative risk of AMI was 2.03 (95% confidential interval 1.55 to 2.66) for the four week period after the disaster compared to the corresponding periods in the preceding years. The number of events peaked within the first week after the earthquake, decreased to levels seen in the preceding years, and then increased again following high magnitude aftershocks. **Conclusions:** This population based study suggests that the increase in AMI events after a major earthquake varies depending on the seismic scale of the initial shock and each aftershock.

A. Purpose

Previous studies have reported a relationship between large earthquakes and acute coronary events, but have yielded conflicting results. On March 11, 2011, a massive magnitude 9.0 earthquake occurred off Japan's Pacific coast and hit the northeast of the country. We have studied the incidence of acute myocardial infarction (AMI) according to the criteria of the World Health Organization (WHO) MONICA project in the community of Iwate prefecture. The aim of this study is to clarify the influence of the 2011 northeast Japan earthquake on the risk of AMI events including sudden cardiac death (SCD) on the basis of data from this population based analysis.

B. Methods

Study population

The study subject was residents in seventeen municipalities located in the east of Iwate prefecture from February 2009 to May 2011. The study region included twelve general public hospitals. Study teams including cardiologists and trained research nurses retrospectively checked medical charts and obtained information regarding the occurrence of AMI and SCD including age at onset, sex, and date of onset. Furthermore, to capture community cases of SCD, we checked death certificates in government offices within the target district. Cases registered in the study were aged ≥ 20 years and occurring between February 11, 2011 (four weeks before the disaster) and May 5, 2011 (eight weeks after the disaster), and in the corresponding periods in 2009 and 2010 as a reference.

Disease definitions

AMI was defined according to the criteria of the WHO MONICA Project. According to the WHO criteria for sudden death, SCD was defined as sudden unexpected death. Cases were registered if they met type 1 definition of the MONICA diagnostic AMI criteria. Approval was obtained from the ethics review board of each participating hospital and Iwate Medical University before commencement of the study.

Statistical analysis

Numbers and characteristics of cases with AMI occurring during the twelve-week period from four weeks before to eight weeks after the day of the earthquake were compared to those during the corresponding periods in the previous two years. For comparison of event incidence before and after the disaster, the relative risk (RR) of AMI incidence and its 95% confidential interval (CI) were calculated from a 2-by-2 table. Furthermore, numbers of AMI cases over these four week periods were analyzed according to sex, age group (< 70 years at onset and ≥ 70 years), and presence of tsunami-induced flooding in more than 10 % of the built-up area. The SI scale of the Japan Meteorological Agency was used. Spearman correlation coefficients were used to examine the association between the scales of weekly maximum SI and weekly incidence of AMI during the twelve-week period. In this analysis, SI scales were substituted with maximum SI measurements taken in each municipality. P values of < 0.05 were considered to be statistically significant.

C. Results

During the four weeks after the disaster (March 11 to April 7, 2011), 96 patients developed AMI corresponding to the MONICA diagnostic criteria. The crude number of AMI cases per 100,000 people has increased after the disaster, and it approximately doubled during the first to fourth weeks after the disaster compared to the corresponding periods in the previous two years. Age, sex, the proportion of diagnostic type of AMI criteria (corresponding to either definite AMI, possible coronary death or unclassifiable SCD) and residential areas of AMI cases did not differ in any period between each year before and after the disaster. The RR for the incidence of AMI during the first four weeks after the disaster was significantly higher compared to the corresponding periods in the previous two years ($p < 0.001$).

We have examined weekly maximum SI and relative risks for weekly incidence of AMI during the twelve weeks before and after the disaster and compared to the corresponding periods in the pre-disaster years. The incidence peaked during the first week after the disaster (RR 2.77, 95% CI 1.73 to 4.43) and then decreased to the levels seen in the preceding years during the second week. The incidence then increased over the following two weeks (RR 1.84, 95% CI 1.05 to 3.24 in the third week; RR 2.00, 95% CI 1.13 to 3.55 in the fourth week). From the fifth week after the disaster, AMI incidence did not differ significantly from the corresponding periods in the previous two years. These trends in weekly incidence of AMI were closely related to the weekly maximum seismic intensity of each earthquake as strong intensity aftershocks occurred repeatedly during the four weeks after the main shock and then decreased markedly.

We have examined the number of AMI cases over two-day period during the two weeks before and after March 11, 2011 plus the corresponding periods in 2009 and 2010. The number of AMI cases peaked over the first two-day period after the disaster. Compared to the corresponding periods in 2009 and 2010, the increase in events was significant for the first (RR 3.89, 95% CI 1.45 to 10.7) and following two-day periods (RR 5.76, 95% CI 1.70 to 21.4) after the disaster. There was no significant difference in the incidence for any of the two-day period before March 11 between the disaster and pre-disaster years.

D. Discussion

Several reports have investigated the effect of earthquakes on cardiac events, yet the results of those reports have not necessarily been consistent. Three community based studies found increase in cardiac mortality on the basis of death certificate reviews; those related to the 1981 earthquake in Athens, Greece, the 1994 Northridge earthquake in the Los Angeles area, and the 1995 Hanshin-Awaji earthquake in Japan. Hospital based studies have shown less consistent results, with an increase in AMI admissions after the Northridge earthquake, but no increase was observed after the 1989 Loma Prieta earthquake in the San Francisco. These disparate results may be due to the variety of end points analyzed in association with earthquakes of different magnitudes along with differences in case identification methodology. Generally, hospital based registration of AMI incidences cannot capture out-of-hospital coronary deaths, while the registration of cardiac mortality based on death certificate review cannot necessarily capture every incidence of AMI events. This suggests that previous studies may have had a limited ability to identify earthquake related AMI events.

In contrast to the present study, a population based study after the Newcastle earthquake in Australia found no significant increase in AMI according to the MONICA diagnostic criteria. This discrepancy may have arisen due to the difference in degrees of magnitude of the two disasters, with the Japanese event measuring magnitude 9.0 and the Newcastle earthquake measuring magnitude 5.6. Furthermore, the Newcastle study was conducted among the population aged < 70 years old, while the present study found a higher incidence of earthquake related AMI events in individuals aged 70 years and older.

The relationship found in this analysis between weekly seismic activity and cardiac events (Fig. 1) that occurred in the same week will be relatively novel. This suggests a rapid causal effect in seismic activity, the associated stress and cardiac events. The aftershocks, most of which caused little environmental damage, could apparently also cause significant psychological distress. In addition, residents have experienced physical distress due to environmental situations such as housing damages and a lack of heating. The psychological or physical stressors lead to activation of the sympathetic nervous system and have cardiovascular effects through hemodynamic alterations acting on vulnerable atherosclerotic plaque or hemostatic alterations such as activation of procoagulant factors. It can be hypothesized that the increased incidence of AMI seen after the earthquake was caused by earthquake induced direct stress rather than by indirect stress induced by environmental damages. However, since the present study did not evaluate different degrees of stress among residents with and without tsunami damages, we cannot provide an explanation for the influence of the tsunami on AMI risk.

The present findings of a correlation between the risk of AMI and the scale of aftershocks suggest that, in large scale earthquakes, it is necessary to recognize the event risk in conjunction with aftershocks as well as the main shock. In this regard, several approaches can be considered for risk prevention. First, medical supports should be maintained after a major earthquake or ensure that such supports are restored as quickly as possible. Lifeline damages and traffic cutoff after disasters would hinder intervention for AMI cases that require an urgent transportation by an ambulance. Second, a preventive approach can be instituted at a public health level with provision of defibrillators and rapid cardiac resuscitation capability to reduce incidences of cardiac death. 20

Study limitations

The present study had several limitations. First, there might have been problems and insecurities in diagnosing AMI events, especially after a major disaster with a strained health care system. In fact, it was impossible to review the medical records of three hospitals located in the survey areas that were flooded by the tsunami. Approximately 6,000 persons, corresponding to 5 % of the study area population, were found dead due to drowning or missing after the tsunami following the initial earthquake, and those persons may have included the cases of AMI. These could lead to an underestimation of tsunami related AMI risk. Secondly, we have previously reported that the incidence of sudden unexpected death was doubled immediately after the disaster. This observation may be similar to the present study. However, in the previous study, only 16% of sudden unexpected death fulfilled the definition of MONICA-AMI. Third, for analysis of a correlation between SI and overall weekly incidence of AMI, the scale selected for analysis was from the municipality where the maximum SI was recorded. Therefore, these scales may not have reflected the actual SI in each municipality. Finally, although the ascertainment of the case was done according to the standard criteria (MONICA), event classification was not done blinded as the nature of the retrospective study. This could be a limitation for classification of suspected AMI events.

Conclusions

This population based study suggests that the increase in AMI events after a major earthquake varies depending on the seismic scale of the initial shock and each aftershock.

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Ｆ．研究発表

１．論文発表
投稿中

２．学会発表
日本心不全学会（仙台）2014 年

Ｇ．知的財産権の出願・登録状況

１．特許取得
特になし

２．実用新案登録
特になし

３．その他
特になし

厚生労働科学研究費補助金（健康安全・危機管理対策総合研究事業）
分担研究報告書

岩手県一自治体の仮設住宅住民における精神疾患の疫学調査

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研究要旨
本調査では、被災地住民における精神疾患の有病率を明らかにするために、2014 年 6-8 月に岩手県被災地Ａ市の仮設住宅の 20 歳以上住民に対して WHO 統合国際診断面接(CIDI)を用いた面接調査を実施した。回答者は 242 名（回収率 55%）であった。回答者中、6.2%が過去 12 か月間に何らかの精神疾患を経験していた。これは同時期の東日本一般住民調査の有病率よりも 1.6 ポイント高かった。大うつ病(3%)、全般性不安障害(2%)、心的外傷後ストレス障害(PTSD)（2%）の頻度が高かった。特に PTSD の有病率は同時期の東日本住民調査での有病率より有意に高かった($p<0.01$)。精神疾患経験者のうち医師受診した者は 27%だった。自殺行動の頻度は低かった。被災の影響は PTSD の増加に顕著であると考えられたが、被災地住民の精神的問題の頻度の観点からは大うつ病、全般性不安障害、PTSD が重要な対象疾患と思われる。

Ａ．研究目的

東日本大震災による被災住民における精神的健康への影響が大きいことは多数の研究により明らかになってきた。しかしこれらの研究はほぼ全てが自己記入式調査票によるものであり、厳密な意味では精神疾患の有無について評価することは難しい。気分障害、不安障害、物質使用性障害などの精神疾患は、単なる精神症状の増加だけでなく、一定の症状パターンと社会機能障害を伴う臨床的意義のある状態である。被災者において精神疾患がどの程度存在するのかについて知ることは、被災住民における精神的健康への影響をより詳細に評価し、また適切な精神保健サービスの計画につながる。本研究では、岩手県の一自治体の仮設住宅住民を対象として、発災後 3 年が経過した時点での、精神疾患の頻度、医師受診率をあらかにすることを目的とした。またその結果を、同時期に実施された東日本一般住民の調査と比較することで、被災地住民で増加している精神疾患は何かを明らかにする。

Ｂ．研究方法

１．対象

岩手県沿岸部に位置するＡ市は、2011 年 3 月 11 日に発生した東日本大震災により大きな被害を受けた。全壊した被災戸数は約 3000 戸、震災による死亡者は 1700 人を上回り、総人口の約７%にのぼった。Ａ市に