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厚生労働科学研究費補助金（地域医療基盤開発推進研究事業）

分担研究報告書

在宅医療の全国展開における在宅医療連携拠点事業の活動性の評価

在宅医療連携拠点事業終了後の追跡調査

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平成 24 年度の当該事業終了後 2 年間の在宅医療連携拠点の活動状況について、追跡調査を行なった。在宅医療介護推進事業へ移行した割合は 20%と少なかった。更に、対象のうち、在宅医療連携拠点活動の継続割合は 60%、中断理由は独自活動の展開のためと回答した割合が最も多かった。在宅医療連携拠点の活動性の指標の推移の検討から、市町村・医師会連携による在宅医療介護連携について、教育・研修システムの構築数、新規在宅医療参入かかりつけ医師数等は減っていたが、市町村・医師会連携による在宅医療・介護提供体制は微増し、年間在宅看取り数は若干増加傾向にあることを明らかにした。

平成 24 年度在宅医療連携拠点の約数割は事業終了後も、各地の在宅医療介護連携の拠点として自立的に活動している可能性が示唆された。市町村・医師会との連携による在宅医療・介護の 24 時間対応体制の構築、かかりつけ医の在宅医療への参入等は今後も継続的取り組むべき課題である。

1.　背景

平成 24 年度在宅医療連携拠点事業は当初 2 年計画の事業であった。しかし、時の政権により事業は 1 年で終了した。平成 25 年度から、地域医療再生基金による在宅医療介護推進事業へ移行した。これは、平成 24 年度までの厚生労働省が主幹するのではなく、各都道府県の裁量で進められる事業である。本来、事業の年数の長短に関わらず、当該事業が終了した後に全国各地に拠点が根づくことが理想的であろう。しかし、事業終了を以て在宅医療・地域包括ケアシステムへの取り組みが中断されることも想像に難くない。

2.　目的

平成 24 年度在宅医療連携拠点事業終了後の継続性と、当該事業後の 1 年と 2 年における活動状況の実態を把握し、在宅医療介護推進状況を検討することであった。

3.　方法

(1) 在宅医療介護推進事業への移行状況の調査：

電話や電子メール等にて、各都道府県の当該事業担当者に進捗状況を確認した。

(2) 該事業後の1年と2年における活動性の追跡調査：

上記を基に、105の主体のうち、平成25年度在宅医療介護推進事業に移行しなかった主体全81を対象に、平成24年度在宅医療連携拠点事業終了後の1年（平成25年）、2年（平成26年）に自記式質問紙郵送調査を行った。

4. 倫理的配慮：当センター研究倫理・利益相反委員会の承認を得て実施した。

5. 結果

(1) 対象

参加の同意が得られた40（回収：49%）を分析対象とした。事業主体の種別を図1に示す。主体別には、病院が45%と最も多く、医師会と行政は各々8%と少なかった。

(2) 在宅医療連携拠点として活動性状況

- 活動の継続状況

事業終了後も在宅医療連携拠点としての活動を継続は60%を占めていた。活動中止の理由は、事業に拠らない独自の活動を展開させるためが最も多く、次に、活動に当たっての資金や人材の確保が困難であるであった。また、各地において医師会や県主体の新たな事業が展開するため敢えて活動は継続しない等であった（図2）。

- 被災地における連携

被災地と一括りはできないが、平成24年度在宅医療連携拠点のうち追跡できた6対象について、在宅医療介護連携の取り組みの一部を図3に示す。

対象の活動地域の人口規模や高齢化率に違いがあった。また、これは、各地域における当該事業の立ち上げの経緯や取り組みの効果や困難点等の記述的なデータと、全国共通の定量的評価指標によるデータを併せた。立ち上げ時に期限付きで人材を確保したが、事業終了後は予算の裏付けないことかその活動継続の困難要因となった。しかし、活動地域内の資源マップの作成と情報提供、在宅医療従事者の交流・憩いの場を設けすことや、電話対応により、在宅看取りが行われていなかった地域において年間9人を看取ることができていた。一方で、24時間対応体制や情報共有システムの導入には取り組でいなかった。

- 在宅医療介護連携の推進とその効果

追跡調査の結果から、在宅医療連携拠点の活動性指標の変化の一部を図4に示す。

各地域における在宅医療多職種連携の活動指標として、連携チームや、市町村・医師会連携による教育・研修システムの構築、新規在宅医療参入かかりつけ医師数は低下していたが、市町村・医師会連携による提供体制数が微増し、地域リーダー数は有意に増加していた。

次に、実際に在宅医療を受けた在宅療養者数について、往診数等は概ね同程度に推移していたが、訪問診療や介護保険による訪問看護利用者数は半減していた。最後に、最期まで住み慣れた地域で過ごすことができたか否かの結果指標である年間在宅看取り数は若干増加傾向であるが、介護施設の年間看取り数は大幅な増減はなかった。

6. 考察

平成24年度在宅医療連携拠点事業終了後2年間の活動性を追跡調査した結果、本研究への参加は平成24年度がほぼ全数であったことに比して、以降は半数程度に激減していた。しかし、そのうち60%が在宅医療連携拠点活動を継続していたこと、継続なしとした対象の中止理由が事業に拠らない各地域の状況に応じた独自の活動の展開であったことから、意識の高い対象である可能性が考えられる。

本研究の対象における在宅医療多職種連携の活動性を評価する指標の推移から、市町村・医師会連携による体制やシステムの構築や人材育成に継続的に取り組んでいたことから、事業終了後も自律的に活動を展開している可能性が示唆された。しかし、在宅医療を担うかかりつけ医師数の低下から、行政と医師会との連携・協力体制や、補完機能については十分でないことが明らかになった。また、在宅医療連携拠点活動の中止理由に、各地の県や医師会との関係性が、在宅拠点の活動に影響を及ぼす可能性が示唆されたと考える。地域包括ケアシステムの構築に向けて、高齢者医療・介護に関する知見と、より中立的な視点を有する機関が、各地域の行政、医師会、関係団体に対して、継続的に教育・研究的な支援を行うこと、関係団体の利害調整を含め介入することが必要であろう。医療介護関係者のみならず地域住民への在宅医療への理解を促す取り組みも必要と考える。

次に、実際に在宅医療を受ける患者数のうち、往診数に変化がみられないものの在宅看取り数に若干の増加がみられたことから、対象の活動により、高齢者が最期まで住み慣れた地域で暮らすことのできる地域となっている可能性は否めない。対象の活動、即ち、在宅医療連携拠点活動による一定の効果がある可能性が示唆された。介護施設での年間看取り数にも変化がなかったことから、自宅に拘らず、高齢者が住む住まいにおける質の高い看取りが推進されることが重要であろう。

従来、在宅医療・介護の領域では、先駆的な取り組みの活動報告や一部の先人たちのマインドによって推進されてきたとも言える。今後は、在宅医療・介護とその連携拠点の機能等について、本研究で用いたようなより定量的なデータを蓄積し、データに基づいた実態の検討と、要因分析が必要となるだろう。

本研究は平成24年度在宅医療連携拠点事業に採択された事業主体を対象としており、当該事業採択における選択バイアスを有する可能性がある。また本研究は観察研究であり、在宅医療連携拠点活動等と在宅医療・地域包括ケアシステムの構築との直接的な因果関係を示すことはできない。また、各地域の潜在的バイアスや交絡要因を有する可能性がある。更に、これら各地域の特性や実情について評価する指標の検討が課題である。

平成 24 年度在宅医療連携拠点の約数割は事業終了後も、各地の在宅医療介護連携の拠点として自立的に活動している可能性が示唆された。一方、市町村・医師会との連携による在宅医療・介護の 24 時間対応体制の構築、かかりつけ医の在宅医療への参入活動は今後も検討課題である(9)。

7. まとめ

平成 24 年度在宅医療連携拠点事業について、平成 24 年度は当センターによる教育・研究的支援についての事業前後比較から、その効果の可能性を示す。追跡調査から、当該事業終了後も約数割に在宅医療連携拠点の活動性を有することを明らかにした。

図1. H25年度：事業主体の内訳

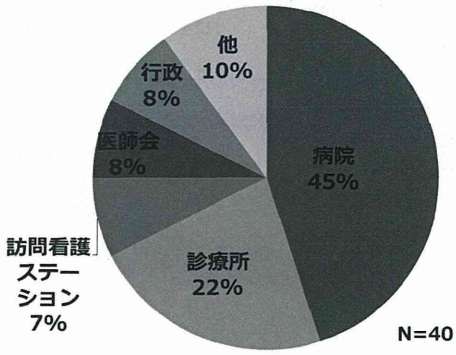
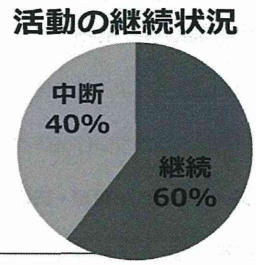


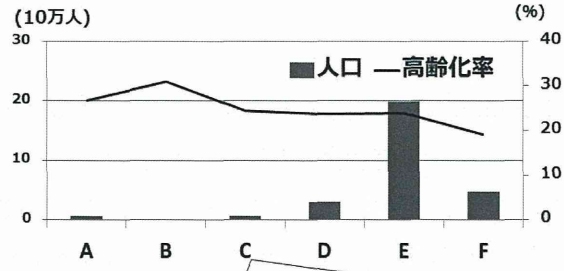
図2. H25年度への継続状況



中断の理由

- 独自活動の展開のため
- 資金確保困難
- 人材確保困難
- 医師会主体の事業が展開するため
- 県直轄の事業が展開するため
- 県行政との連携がない
- 小児に関する活動を行うため

図3. 被災地における在宅医療連携拠点の連携

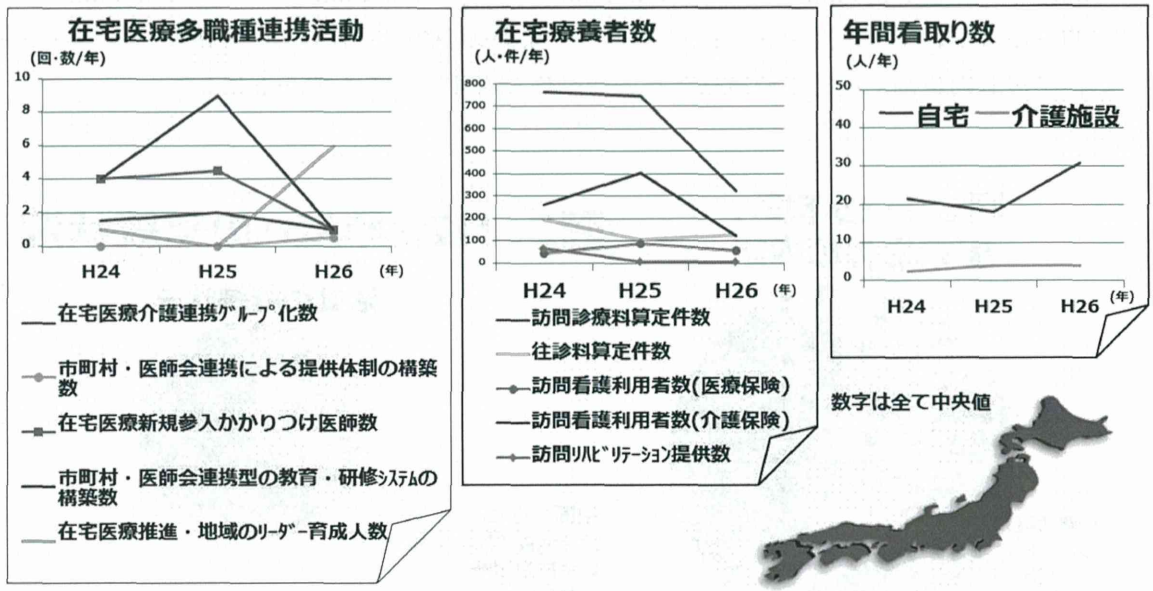


<記述的データから>

- 拠点立ち上げ時の経緯
  - 県保健福祉事務所の後押しあり、代表が医師会副会長兼在宅関係を担当
  - 期限付きでも人材確保し体制をつくった
- 在宅医療多職種連携の取組みと効果
  - 活動地域内の全施設へ実際に訪問し面談
    → 地域資源ガイド作成(パンフレット等) →医療・介護従事者へ情報提供
  - 電話対応(53件/年) …→在宅看取り:0⇒9件
  - 在宅医と訪問看護の交流会の設定→懇いの場の設定
- 在宅拠点活動の困難点
  - 市町村を動かすための継続的予算の裏付けが必要

図4. 在宅医療連携拠点の活動性評価: 追跡調査

◆活動性指標の変化



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Ⅲ. 研究成果の刊行に関する一覧表

研究成果の刊行に関する一覧表

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Sugiura S, Yasue M, Sakurai T, Sumigaki C, Uchida Y, Nakashima T, Toba K.	Effect of cerumen impaction on hearing and cognitive functions in Japanese older adults with cognitive impairment	Geriat Gerontl Int	14(S2)	56-61	2014
Hirai H, Kondo N, Sasaki R, Iwamuro S, Masuno K, Otsuka R, Miura H, Sakata K.	Distance to retail stores and risk for being homebound among older adults in a city severely affected by the 2011 Great East Japan Earthquake. doi: 10.1093/ageing/afu146	Age and Ageing	First published online		2014
Aiko Ishiki, Katsutoshi Furukawa, Kaori Une, Naoki Tomita, Shoji Okinaga and Hiroyuki Arai	Cognitive examination in older adults living in temporary apartments after the Great East Japan Earthquake	Geriat Gerontl Int	15	232-233	2015
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杉浦彩子、安江穂、内田育恵、伊藤恵里奈、中島務	認知機能障害のある難聴高齢者に対する補聴器適合	Audiol Jpn	58(1)	in press	2015
福岡秀記、山中行人、長屋政博、鳥羽 研二、木下 茂	日本の介護老人保健施設における眼疾患に関する検討	臨床眼科	68(6)	865-868	2014
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引地博之、近藤克則、相田潤、近藤尚己	集団災害医療における「人とのつながり」の効果－東日本大震災後の被災者支援に携わった保健師を対象としたグループインタビューから－	集団災害医学会誌		印刷中	
大島浩子、鳥羽研二、鈴木隆雄	高齢者の医療介護体制とイノベーション.地域包括ケアシステム構築への取組	医学の歩み	253(9)	印刷中	2015

研究成果の刊行に関する一覧表

著書

発表者氏名	論文タイトル名	書籍全体の編集者名	書籍名	出版社名	出版地	出版年	ページ
杉浦彩子	驚異の小器官　耳の科学	杉浦彩子	驚異の小器官 耳の科学	講談社	東京	2014	1-220
菊地和則、三澤仁平、大塚理加	訪問介護事業所と訪問看護ステーションの地域連携に関する調査報告書	菊地和則	訪問介護事業所と訪問看護ステーションの地域連携に関する調査報告書	東京都健康長寿医療センター研究所	東京	2015	1-120

Ⅳ. 研究成果の刊行物・別刷

Geriatrics Gerontology International
Medline Indexed

Geriatr Gerontol Int 2014; **14 (Suppl. 2):** *56–61*

ORIGINAL ARTICLE

Effect of cerumen impaction on hearing and cognitive functions in Japanese older adults with cognitive impairment

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Aim: To assess the effect of cerumen impaction and its removal on hearing ability and cognitive function in elderly patients with memory disorders in Japan.

Methods: Pure tone audiometry (PTA) and the Mini-Mental State Examination (MMSE) were administered to participants before and after cerumen removal. Participants who had cerumen impaction in the better-hearing ear comprised the case group; the control group consisted of participants who either did not have cerumen impaction or had it in the worse hearing ear. Hearing and cognition changes were compared between the groups after cerumen removal.

Results: A total of 55 patients who completed all examinations were assigned to the case group (29 patients) or the control group (26 patients). The average hearing change was 4.6 ± 7.4 in the case group and 0.9 ± 0.9 in the control group ($P = 0.029$). The average change in MMSE score was 0.7 ± 2.5 in the case group and −1.0 ± 4.1 in the control group ($P = 0.068$). The case group showed a significant improvement in MMSE scores after age adjustment compared with the control group ($P = 0.049$).

Conclusion: Hearing improved significantly in the case group relative to controls after cerumen removal. A significant cognitive improvement in the case group relative to controls was additionally observed after cerumen removal with age adjustment. Thus, the present results suggest routine ear canal examinations might benefit elderly individuals with memory disorders. **Geriatr Gerontol Int 2014; 14 (Suppl. 2): 56–61.**

Keywords: cognitive impairment, dementia, hearing impairment, Mini-Mental State Examination, pure tone audiometry.

Introduction

Cerumen is a complex of ceruminous and sebaceous gland secretions, and various other substances in the ear canal. Dry and wet variations of cerumen are found in humans, and the presence of either is different among the ethnic groups.[1] The wet variation is present in over 90% of white and black people. A combination of wet and dry variations is seen in populations of certain parts of the Middle East and Southeast Asia. The dry variation is major in North China, Korea and Japan, and is present in approximately 70–80% of Japanese people.

Cerumen impaction is more common in children, the elderly and individuals with an intellectual disability.[1] Indeed, the prevalence of cerumen impaction appears to increase with age in adults; in the geriatric population (those aged 65 years and older), the incidence of cerumen impaction is reportedly 19–34%.[2–4] Furthermore, studies have shown that people with an intellectual disability have a higher prevalence (24–25%) of cerumen impaction, regardless of age.[5,6] Cerumen impaction is also more likely to occur in people with wet type cerumen.[1] Cerumen impaction leads to itching, pain, hearing loss, tinnitus, vertigo and choronic otitis externa. Hearing loss caused by cerumen impaction is up to 40 dB.[7] The prevention of hearing loss is advantageous, because hearing loss has been implicated as an independent risk factor for cognitive impairment and

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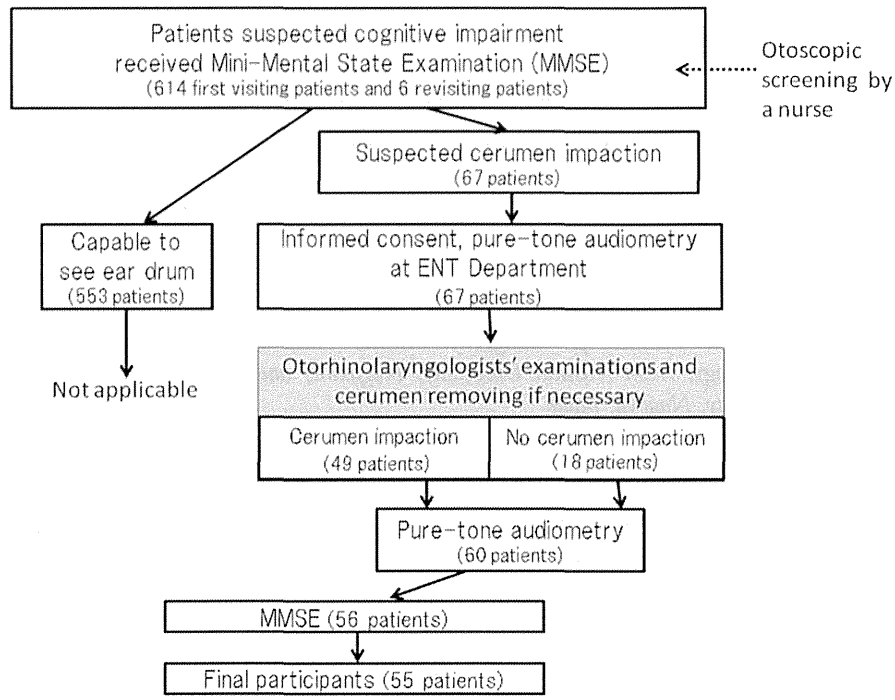

Figure 1 Study protocol.

dementia.[8,9] Moore *et al.* studied the influence of cerumen impaction clearance on Mini-Mental State Examination (MMSE) performance.[10] In their study, 65.5% of the participants had cerumen in at least one ear, and hearing and the MMSE score improved significantly in participants with impacted cerumen after cerumen removal. In an earlier study, we reported that cerumen impaction of the better-hearing ear (BHE) was observed in 10.7% of community-dwelling Japanese older adults aged older than 60 years.[11] Cerumen was significantly associated with poorer hearing and a lower MMSE score.

The aim of the present study was to investigate the potential contribution of cerumen impaction and cerumen removal on hearing and cognitive function in Japanese patients with memory disorder.

Methods

Participants

The participants were 67 patients (28 males, 39 females; mean age 81.7 ± 5.6 years) who visited the Center for Comprehensive Care and Research on Memory Disorders (CCCRMD), National Institute for Longevity Science, National Center for Geriatrics and Gerontology between 9 July to 30 November in 2012. The study protocol was approved in advance by the Committee of the Ethics of Human Research of the National Center for Geriatrics and Gerontology (NCGG). The study protocol is shown in Figure 1. The patients who visited the center because of a memory disorder were first asked to complete the MMSE and were then given an otoscopic screening by a nurse. If cerumen impaction was suspected, it was recommended to the patients that they visit the Ear, Nose and Throat (ENT) Department, and detailed information regarding the present study was provided to them at the ENT department. Written informed consent was obtained from each patient who agreed to participate in the study. The initial audiometric test was carried out before evaluation of the ear by otorhinolaryngologists. After the pure tone audiometry (PTA) assessment, the participants were given ear canal examinations by an otorhinolaryngologist and cerumen removal was carried out, if necessary. Regardless of whether significant cerumen impaction was observed, the PTA assessment was administered to participants. The second MMSE was administered weeks to months later at the center. Participants who could not complete the PTA or MMSE were excluded from the present study. Seven participants could not complete the PTA because of poor reproducibility. Four participants refused to complete the second MMSE. One participant was excluded from the study because she began memantine hydrochloride regimen between the first and the second MMSE. Thus, the total number of participants was 55 (25 male, 30 female; mean age 81.3 ± 5.8 years, range 68–93 years). A total of 33 of the participants were not taking medications to treat dementia at any time during the study. The remaining 12 patients were taking medication for memory disorders during the study period (memantine hydrochloride: 2 patients, donepezil hydrochloride: 8 patients, memantine and donepezil: 2 patients); however, these

patients did not begin, end or change medications during the course of the study.

Functional assessment

The MMSE[12] was administered to participants by clinical psychologists both before and after the otological examination. Functional assessment was also administered using the Barthel Index[13] before the otological examination.

The PTA measurement was carried out by a clinical laboratory technician using a diagnostic audiometer (AA-75; RION, Tokyo, Japan) that was calibrated according to Japanese Industrial Standards T 1201. The air-conduction pure tone average of hearing thresholds (AHT) of the right and left ears were calculated as the average of 0.5, 1, 2 and 4 kHz for each ear before and after the otological examination. The BHE was decided by the AHT after cerumen removal.

Ceruman removal was carried out under a microscope using irrigation and suction procedures. Cerumen impaction was diagnosed if the volume of cerumen exceeded one-third of the ear canal.

The MMSE-administering psychologist and the audiometric examiner were uninformed about the presence or absence of cerumen impaction.

A questionnaire assessing participants' frequency of ear cleaning, cerumen type, and incidence of itching within the ear canal was also administered to the participants and their family. Ear cleaning less than once a month was defined as no ear cleaning.

Statistical analysis

The participants who completed the entire process were divided into two groups. The case group consisted of participants who had cerumen impaction in the BHE, whereas the control group included participants who either did not have cerumen impaction both or had it only in the worse hearing ear.

Statistical analyses were carried out using the statistical analysis system (SAS) version 9.3 (SAS Institute, Cary, NC, USA). Unless otherwise stated, all values are presented as the mean ± SD. The χ^2-test for categorical variables and the Student's *t*-test for continuous variables were used to assess differences in characteristics between the two groups. A general linear model for assessment of correlation between changes in MMSE score and changes in the AHT of the BHE was carried out in the case group. Then, a general linear model adjusted by age, sex, baseline MMSE score and changes in the AHT of the BHE was used to assess differences in the changes in MMSE score between the case and control groups. A value of $P < 0.05$ was considered statistically significant.

Results

Table 1 shows the characteristics of participants with and without cerumen impaction. There were no significant differences in age, sex, Barthel Index score, AHT of the BHE, baseline MMSE score or duration of the first and the second MMSE between the two groups. There

Table 1 Participant characteristics and changes in pure tone audiometry and MMSE scores after cerumen removal

	All participants	Cerumen impaction of BHE	No cerumen impaction of BHE	*P*-value†
n	55	29	26	
Age	81.3 ± 5.8	79.9 ± 5.4	82.8 ± 5.8	0.055
Male, *n* (%)	25 (45.5%)	15 (51.7%)	10 (38.5%)	0.324
No ear cleaning, *n* (%)	23 (41.8%)	15 (51.7%)	8 (30.8%)	0.222
Wet type earwax, *n* (%)	14 (25.5%)	7 (24.1%)	7 (26.9%)	0.735
Ear canal itching, *n* (%)	16 (29.1%)	6 (20.7%)	10 (38.5%)	0.274
Baseline AHT of BHE (dB)	42.6 ± 15.5	43.2 ± 15.4	41.9 ± 15.8	0.748
Barthel Index‡	90.4 ± 13.8	89.0 ± 14.4	91.8 ± 13.3	0.483
AHT of BHE after cerumen removal (dB)	39.8 ± 14.1	38.6 ± 12.5	41.0 ± 15.9	0.535
Change in AHT (dB)	2.8 ± 6.4	4.6 ± 7.4	0.9 ± 0.9	0.029
Baseline MMSE score	18.0 ± 6.3	17.6 ± 6.6	18.5 ± 6.0	0.61
MMSE score after cerumen removal	17.9 ± 6.7	18.3 ± 6.8	17.5 ± 6.7	0.657
Change in MMSE score	−0.1 ± 3.4	0.7 ± 2.5	−1.0 ± 4.1	0.068
Time between MMSE (days)	41.0 ± 28.4	43.2 ± 34.2	38.4 ± 19.6	0.549

Data presented as mean ± standard deviation. †The *t*-test for continuous data, χ^2-test for categorical data. ‡One participant in the no cerumen impaction of best hearing ear (BHE) group and two participants in cerumen impaction of BHE group did not have the Barthel Index estimated. AHT, air-conduction pure-tone average of hearing thresholds; MMSE, Mini-Mental State Examination; PTA, pure tone audiometry.

Table 2 Results of the general linear model

Adjustment	Change in MMSE score in case group	Change in MMSE score in control group	*P*-value
	0.7 ± 0.6	−1.0 ± 0.7	0.068
Age	0.8 ± 0.7	−1.1 ± 0.7	0.049
Sex	0.7 ± 0.6	−1.2 ± 0.7	0.05
Baseline MMSE	0.6 ± 0.6	−1.0 ± 0.7	0.079
Changes in AHT of BHE	0.7 ± 0.6	−1.1 ± 0.7	0.065
All of above	0.8 ± 0.7	−1.3 ± 0.7	0.043

Data presented as least mean square ± standard error. AHT, air-conduction pure-tone average of hearing thresholds; BHE, best hearing ear; MMSE, Mini-Mental State Examination.

was a non-significant trend in the case group towards a lower incidence of ear cleaning and ear canal itching. There were no significant differences in the prevalence of wet type cerumen between the case group (24.1%) and the control group (26.9%). Changes in AHT were significantly larger in the case group than in the control group. Differences in MMSE score before and after otorhinolaryngological intervention differed with marginal significance between the case group and control group ($P = 0.068$).

Two participants classified as having severe hearing loss before cerumen removal (an AHT of 70 dB or greater) were reclassified as having moderate hearing loss (an AHT of 40–69d B) after cerumen removal. Two participants classified as having moderate hearing loss before cerumen removal were reclassified as having mild hearing loss (an AHT of less than 40 dB) after cerumen removal. There was a marginal significant correlation between hearing improvement and differences in the MMSE scores ($R^2 = 0.166$, $P = 0.079$).

Table 2 shows the results of the general linear analysis. There was a significant improvement in MMSE score in the case group after cerumen removal compared with the control group, after adjusting for age; however, adjusting for sex, baseline MMSE score or AHT change rendered this improvement non-significant. Nevertheless, a significant effect of BHE cerumen impaction on the change in MMSE score was observable even after the addition of all adjustments. Furthermore, the only measured variables that significantly affected the changes in MMSE scores after cerumen removal was BHE cerumen impaction ($P = 0.043$; age: $P = 0.297$, sex: $P = 0.300$, baseline MMSE score: $P = 0.323$, change of AHT: $P = 0.894$).

Discussion

In the present study, hearing improved significantly in participants who had BTE cerumen impaction after cerumen removal, and a significant cognitive improvement in the case group relative to controls was observed after cerumen removal with age adjustment.

The cognitively impaired older adults are suggested to have high rates of cerumen impaction, because older adults and people with an intellectual disability have been found to show high prevalence rates of this condition.[2–6] Moore *et al.* reported that 65.6% of residents in a skilled nursing facility had cerumen impaction in at least one ear.[10] The reason for a higher prevalence of cerumen impaction in people with an intellectual disability is still unknown. Several possibilities include poor hygiene and anatomical abnormalities of the ear canal, such as stenosis with Down syndrome, were suggested as possible causes. The reason for a higher prevalence of cerumen impaction in older adults is more clearly accounted. As the skin in the ear canal ages, the surface epithelium thins, the subcutaneous tissue atrophies, the ceruminous glands and the sebaceous glands produce less oil, and the hair in the ear canal lengthens.[1] All of these changes inhibit the excretion of cerumen. Furthermore, the tendency of aging ear canal skin to bleed easily renders cerumen removal aversive and consequently less frequent. Previous reports about the prevalence of cerumen impaction have been from countries where the wet variation of cerumen is present in 90% of the population. In Japan, an estimated 70–80% of the population has the dry variation of cerumen. In a previous study, we reported that cerumen impaction of the BHE was suspected in 10.7% of community-dwelling Japanese older adults above the age of 60 years.[11] However, we only examined the ear canal by otoscopy in that previous study, and thus could not confirm the degree of impaction. In the present study, in which we were limited to first-visit patients at the CCCRMD, 7.0% (43 of 614) of participants had cerumen impaction that exceeded one-third of the ear canal. This frequency was quite low compared with Western countries.[2–4,10] The prevalence of wet type

cerumen in the present study was 25.5%, and the incidence of wet cerumen with impaction and wet cerumen without impaction was not significantly different. The cause of a non-significant incidence of wet cerumen impaction in the present study might be due to the low participants. Furthermore, that genetic diagnosis of wet cerumen was not carried out was a limitation of the present study.

Hearing loss has been reported as an independent risk factor for cognitive impairment and dementia.[8,9] Moore *et al.* reported significant improvement of hearing and MMSE score after cerumen removal.[10] Similarly, Oron *et al.* reported a significant difference in participants' Raven's Standard Progressive Matrices Test scores before and after cerumen removal.[14] In the present study, the change in MMSE score during 40 days in the case group was 0.7, whereas the change in MMSE score in the control group was −1.0. Uhlmann *et al.* reported that a decline in MMSE score in hearing impaired senile dementia of the Alzheimer's type was nearly double that of normal hearing patients.[15] The means of AHT of BTE in the participants of the present study were over 40 dB, thus moderate hearing loss might accelerate the decline of MMSE score, whereas the improvement of hearing partially improved the MMSE score during 40 days. It is possible that hearing improvement is directly or indirectly associated with cognitive function. In the present study, the change in AHT showed a marginal association with the change in MMSE score. Thus, the improvement in MMSE score might result from the direct and the indirect effect of hearing, such as stimulation from environmental sounds and improved speech recognition. The medical sequelae of cerumen impaction include tinnitus, a feeling of fullness in the ear, pain, hearing loss, vertigo, cough and external otitis.[1] Elimination of these peripheral symptoms of cerumen impaction might also contribute to cognitive improvement. Further investigations that clarify the effect of ear canal hygiene on hearing and cognitive function for longer period are necessary.

Although the prevalence of cerumen impaction is low in Japan compared with Western countries, cerumen removal can have similar effects on hearing and cognition. Thus, routine ear canal examinations and cleaning could benefit older adults in Japan. Although methods for wet type cerumen removal have been investigated,[16] there is minimal information regarding the removal of dry type cerumen. The use of ear picks sometimes causes severe injury of the ear.[17] It has also been warned that the use of a cotton tip increases the risk of cerumen impaction and otitis externa.[18] Therefore, the development and assessment of effective methods for removal are imperative.

The present study found that 7.0% of new patients with memory disorders had cerumen impaction. Evaluation of hearing after cerumen removal resulted in a statistically significant improvement. Improvement in cognition relative to controls was also significant after adjustment for age. Thus, routine ear canal examinations can benefit older adults with memory disorders.

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Disclosure statement

The authors declare no conflict of interest.

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Distance to retail stores and risk of being homebound among older adults in a city severely affected by the 2011 Great East Japan Earthquake

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Abstract

Background: after the Great East Japan Earthquake in 2011, inactivity and the homebound status of older victims in affected areas have been a serious public health concern owing to the victims' prolonged existence as evacuees in mountainous areas.
Objective: to evaluate the association between distances to retail stores and risks of being homebound.
Design: secondary analysis of cross-sectional interview survey data with a geographical information analysis.
Setting: Rikuzentakata, Iwate, a municipality seriously damaged by the 2011 earthquake and tsunami.
Subjects: all Rikuzentakata residents aged 65 or older except for those living in temporary housing ($n = 2,327$).
Methods: we calculated road distances between each residential address and retail stores, hawker sites and shopping bus stops, accounting for the extra load caused by walking on slopes. The prevalence ratio of being homebound adjusted for age, source of income and morbidity by road distance was estimated using Poisson regression with a generalised estimating equation.
Results: those living at distances of 1,200 m or more were 1.78 (95% confidence intervals, 1.03–3.08) times more likely to be homebound (going out only every 4 or more days a week) among men and 1.85 (1.13-3.02) among women, compared with those residing in places <400 m from retail stores or shopping bus stops. The distances were reduced by new hawker and shopping bus services, but the improvements varied greatly across the districts.
Conclusions: access to daily needs is essential to prevent homebound status. Post-disaster community diagnosis in terms of the built environment is important for strategic community restoration.

Keywords: *older people, built environment, disaster, homebound, Japan*

Introduction

On 11 March 2011, the Great East Japan Earthquake occurred, and a massive tsunami with a maximum wave height of 40 m caused destruction to many cities along 500 km of Japan's north-eastern coast; it directly killed 15,882 people and 2,668 individuals are still missing [1]. The recovery process has been slow owing to the overwhelming scale of the damage. After the disaster, people who originally resided in tsunami-hit coastal areas and many affected cities evacuated to other cities or nearby areas in the mountains. In the affected cities, access to such places as retail stores and

the availability of public and business services worsened. Those access barriers probably increased the risk of older evacuees becoming physically and social inactive. One survey reported that 30% of respondents cited poor access to transportation as the prime reason for not going out; this was followed by a lack of purpose or places to go (16%) and a lack of motivation to go out (16%) [2].

Numerous studies have reported that among older adults, physical and social inactivity in addition to homebound status are important risk factors for functional decline and death [3–8]. In particular, the homebound lifestyle of older adults has been an area of serious public health concern [1]. However, the effects of access difficulties on older adults' inactivity after the 2011 disaster have not been studied.

The purpose of this study was, therefore, to evaluate the effect of the built environment in terms of physical access to retail stores on older adults' inactivity in a city severely affected by the disaster. We focused on retail stores (including grocery stores, convenience stores, supermarkets and shopping centres), because shopping has been identified as a primary reason for going out in the daily lives of older Japanese adults: a national representative survey reported that 66.2% of older respondents selected 'shopping' as their main reason for going out [5].

Methods

Data

Rikuzentakata, the site of this study, was one of the cities most seriously damaged by the disaster: of its total population of 23,302 before the catastrophe, 1,773 people died or are still missing. Like many cities affected by that tsunami, Rikuzentakata is a rural area, and it had a highly aged population before the disaster: 34.9% of its population was aged 65 years or over in 2010 [9].

Forest accounted for 80.6% of the total land area, and most areas of flat land were located by the coast or around river estuaries (see Supplementary data, Appendix Table S1 available in *Age and Ageing* online). Before the earthquake, the population was concentrated in the flat coastal areas. Of 7,730 houses, 3,368 (43.6%) were affected by the disaster and 3,159 were 'completely destroyed' [9]. Since the community infrastructure in the flat areas was also totally shattered, many victims who lost their houses insisted on moving to areas in the mountains (Figure 1) [10].

We used the data of the third wave of the Health and Living Condition Survey conducted by the Rikuzentakata city government. The home-visit interview survey was carried out from August 2012 to October 2013 among all residents of

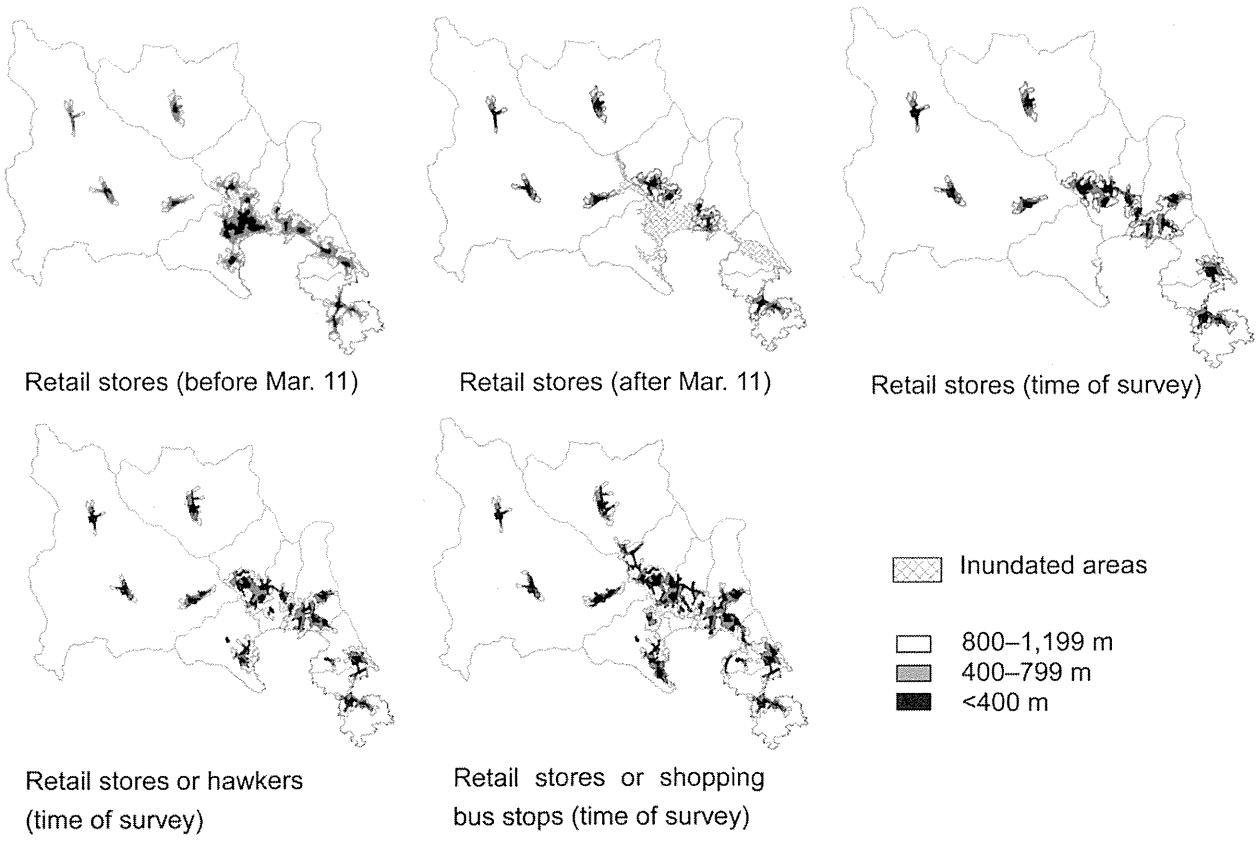

Figure 1. Road distance areas from retail stores, hawker sites and shopping bus stops before the earthquake (on 11 March 2011), just after the earthquake and the time the survey started (August 2012).

6,027 households on the resident registry. Individuals living in temporary housing as earthquake victims were not surveyed, because those individuals had been previously surveyed. Among them, 3,855 households responded to the interviews (response rate = 64.0%). Interviewers gathered information on current morbidity, socio-economic status, health behaviour (eating meals and snacks, smoking status and amount of alcohol consumed per day), frequency of going out and social support. Of 11,370 respondents in total, we used the data of 4,149 people who were 65 years or older. We eventually employed the data of 2,327 older adults with the necessary information for this analysis, including accurate residential address.

Geographical information

We obtained information on grocery stores, convenience stores and shopping centres from the online community directory database Town Page (NTT data, Tokyo, Japan) in August 2012. We removed data relating to facilities in the areas directly hit by the tsunami. Information on shopper bus stops and hawker sites was provided by the disaster support team of Iwate Prefecture Consumer Cooperative. We used ArcGIS data collection (ESRI, Redlands, CA, USA) for road network data; where road information was lacking, we referred to road data of digital national land information [11]. Using these data, we calculated three distances related to road networks: the distance to the nearest retail stores; distance to retail stores or hawker sites and distance to retail stores or shopper bus stops. Following the study by Satoh *et al.* [12], we assumed that going uphill and downhill require extra effort to move and we penalised slope angles on the road by putting a weight of

$$1 + \sin\theta$$

on the surface road distance, where θ represents the slope angle. Slope angle data were obtained from the 10 m mesh altitude data of digital national land information. The data were linked to road data using geographical information systems.

Measurements

Dependent variables: homebound

Following recent reviews, homebound status was determined by the frequency of going out [4]. Respondents were asked about the frequency of going out, and the response options were as follows: (i) daily; (ii) once every 2 or 3 days; (iii) once every 4 or 5 days and (iv) less than that (i.e. once every 6 days or more). We dichotomised the responses and determined those who went out once every 4 or more days as homebound.

Explanatory variables

Our main explanatory variables were road distances from the residential addresses to retail stores (including small grocery stores, convenience stores and supermarkets), hawker sites and shopping bus stops. After the earthquake, private stores and consumer cooperatives started hawker sales for people residing in regular or temporary housing located in remote areas. Shopping bus services were also improved, covering wider areas than before the earthquake. Shopping buses take passengers to a shopping area located in the city centre for free.

Co-variates

As potential confounding factors, we used age, morbidity (diabetes, hypertension, hyperlipidaemia, heart diseases, brain diseases, cancers, orthopaedic disorders, psychiatric disorders, asthma, allergic diseases and other conditions), types of income (pension, wage, none and other) and availability of contact with neighbours (yes or no).

Statistical analysis

Geographical information analysis

The calculated road distances were divided into four categories: <400 m, 400–799 m, 800–1,199 m and 1,200 m or more. First, we visually evaluated the changes in the areas covered by those road distances. We then calculated the population coverage for the road distances to retail stores, hawker sites or bus stops in terms of eight districts. For this, we used the geographical information systems software ArcGIS.

Epidemiological analysis

We then linked the results of the geographical information analysis to the survey data. We first evaluated the prevalence of homebound status according to the respondents' socio-demographic status, district of residence and distance to retail stores or shopping bus stops. Then, we used Poisson regression with a log link function to evaluate the association between those distances and the risks for homebound status, considering potential confounding factors. We separately created three models using the distances to the nearest retail store (Model 1), retail store or hawker site (Model 2) and retail store or shopping bus stop (Model 3). To address clustering within households, we used the generalised estimating equation (GEE) technique. All analyses were categorised by gender. The GEE was required, despite the gender stratification, because there were some addresses at which more than one older couple resided. We employed SPSS version 22 (IBM, Armonk, NY, USA) for the analysis. All P values were two-tailed.

Results

Geographical analysis

As expected, most of the retail stores, hawker sites and shopping bus stops were in areas that had not been reached by the tsunami (see Supplementary data, Appendix Figures S1 and S2 available in *Age and Ageing* online). The geographical distribution of the road distances to retail stores, hawker sites

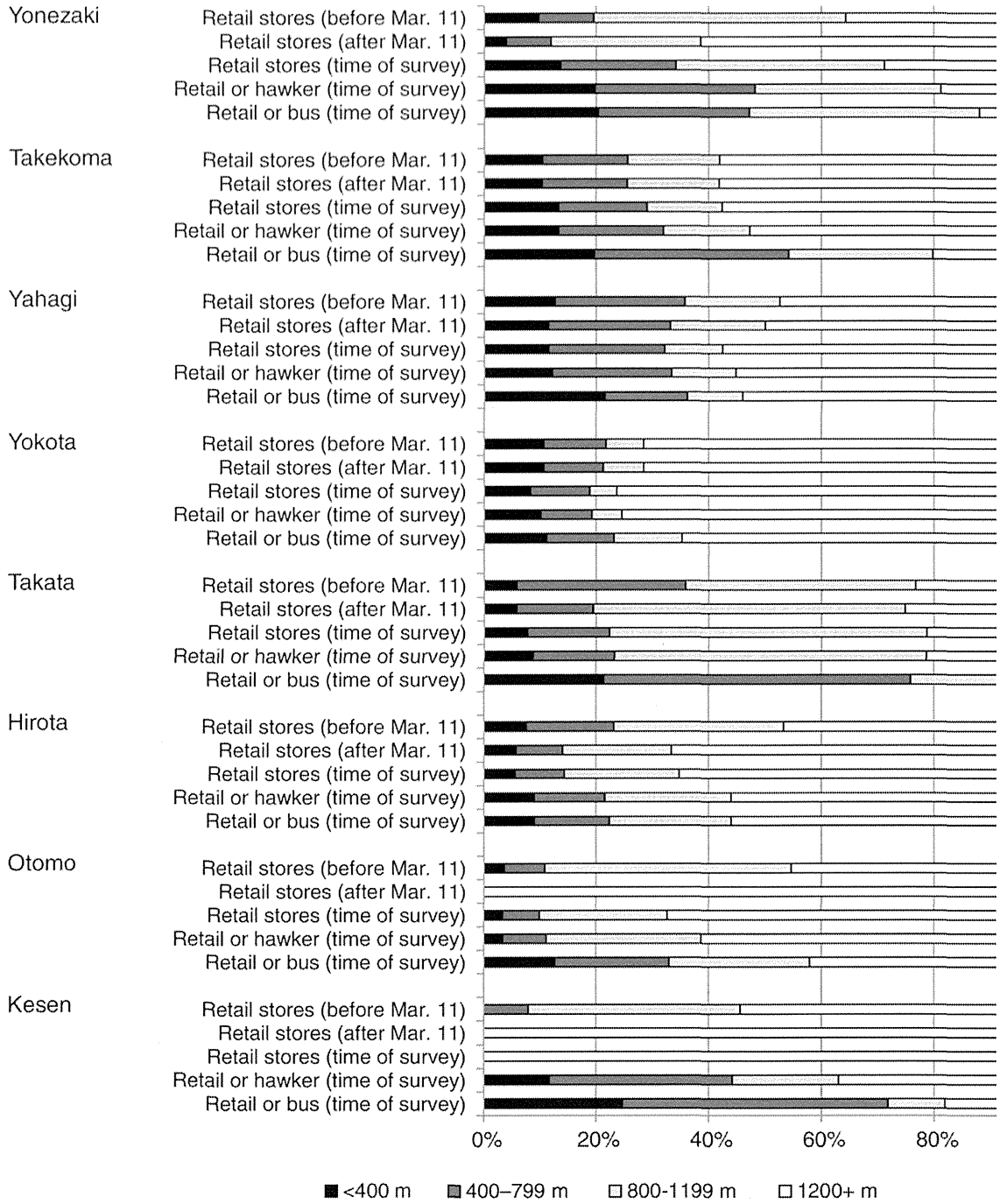

Figure 2. Population coverage by the road distances to retail stores, hawker sites and shopping bus stops by district and by period (before March 2011; just after March 2011 and time of survey started, August 2012).

and shopping bus stops dramatically changed before and after the earthquake (Figure 1). The coverage of populations within a certain road distance to those facilities also underwent a major change (Figure 2). Baseline coverage and the degree of changes varied across districts. Just after the earthquake in Yonezaki, Otomo and Kesen districts, the distances to retail stores largely increased. In the latter two districts, all residential addressees were 1,200 m or more from the nearest retail store. In Otomo, however, the re-opening of a new shopping centre, previously located in a tsunami-affected coastal area, contributed to the increased coverage of areas that were less distant to retail stores (32.7% of residential addresses were within 1,200 m of the nearest retail store). In Kesen, although no retail stores opened afterward and the distance to the nearest retail store did not change, the distance to retail stores, hawker sites or shopping bus stops largely decreased owing to newly introduced hawker and shopping bus services.

Table 1. Prevalence ratios for being homebound by road distance to nearest retail store, hawker site or shopping bus stop after the Great East Japan Earthquake, 11 March 2011, in the city of Rikuzentakata, 2012–13

	Men			Women		
	n	PR (95% CI)	*P*	*n*	PR (95% CI)	*P*
Model 1: to retail store						
−399 m	92	1		104	1	
400–799 m	126	1.30 (0.71–2.37)	0.40	183	1.28 (0.75–2.18)	0.37
800–1,199 m	219	1.39 (0.80–2.42)	0.24	250	1.36 (0.82–2.25)	0.24
1,200+ m	590	1.39 (0.83–2.30)	0.21	763	1.54 (0.97–2.44)	0.07
Model 2: to retail store or hawker site						
−399 m	124	1		138	1	
400–799 m	170	0.99 (0.63–1.55)	0.96	244	0.94 (0.64–1.37)	0.74
800–1,199 m	238	1.23 (0.79–1.89)	0.36	277	1.45 (1.02–2.05)	0.04
1,200+ m	495	1.40 (0.96–2.04)	0.07	641	1.45 (1.05–2.00)	0.02
Model 3: to retail store or shopping bus stop						
−399 m	176	1		205	1	
400–799 m	220	1.18 (0.59–2.35)	0.63	305	1.33 (0.75–2.36)	0.33
800–1,199 m	228	1.49 (0.81–2.74)	0.20	282	1.73 (1.02–2.95)	0.04
1,200+ m	403	1.78 (1.03–3.08)	0.04	508	1.85 (1.13–3.02)	0.01

All models were adjusted for age, sources of income, morbidity and available contacts/neighbours.

Epidemiological analysis

Among the 2,327 participants, 1,027 (44.1%) were men and 1,300 were women (55.9%), with average ages of 75.5 and 77.2 years, respectively. Overall, the proportions of homebound people were 19.6% for men and 23.2% for women, with higher proportions in the older age groups. There was an over 3-fold regional difference across the eight districts—from 7.9% among women in Kesen to 34.8% among women in Yokota. Linking geographical information with survey data, we found that people residing at greater distance from retail stores, hawker sites or bus stops were likely to be homebound (see Supplementary data, Appendix Table S2 available in *Age and Ageing* online).

Overall, the GEE–Poisson regression showed a positive association between road distances to retail stores or shopping bus stops and the risk of being homebound. For example, among men, the adjusted prevalence ratio (PR) for homebound status among those whose residential address was 1,200 m or more from the nearest retail store or hawker site compared with <400 m was 1.40 (95% confidence interval [CI], 0.96–2.04); the adjusted PR was 1.78 (95% CI, 1.03–3.08) for those living 1,200 m or more from the nearest retail store or shopping bus stop. These associations were comparable in all the models for women, though women rather showed narrower CIs and smaller *P* values (the *P* values for women in the >1,200 m category were <0.05 in all models) (see Supplementary data, Appendix Table S3 available in *Age and Ageing* online for full descriptions of those models; Table 1).

Discussion

Our analysis found that, even after controlling for age, income status, mental and physical health status (morbidity) and social integration, the older men and women residing at great distance from shopping facilities were more likely to be homebound or not go out frequently; however, the association between distance and homebound status was not clear for those with a road distance of under 800 m. Although the distance to shopping facilities may be a risk of being homebound, the newly started shopping bus and hawker services in Rikuzentakata may have provided more opportunities for going out.

Potential reasons for the positive association between distance to retail stores or shopping support services and going out infrequently are as follows. (i) The distance itself is a physical barrier to going out. (ii) The distance may also be a psychosocial barrier—giving rise to feelings of being neglected or excluded from society, which may in turn reduce the willingness for going out. (iii) It is also possible that some people who reside in distant areas from those shopping destinations may not need to go out, because they have sufficient instrumental support for obtaining daily necessities through, for example, their children or younger neighbours.

To our knowledge, this is the first study evaluating the association between distances to certain facilities in a built environment and the risk of homebound status of older adults. The strengths of this study were utilising the data of a home-visit survey for all people who resided in their own or rented accommodation as well as detailed, objective geographical information. The accurate information on distances relating to road networks is another advantage. Nonetheless, a major limitation of this study is that we did not account for the means of transportation. Some people may use motor vehicles, potentially leading to the underestimation of the association between road distance and their inactiveness. This may explain the gender differences observed, with more precise estimates being obtained for women than men. In Japan, older women are less likely to drive a car and possess a licence; misclassification may thus be smaller among women. Another issue is the self-reported, limited information obtained from the survey: this raises the possibility of potential information biases and residual confounding. Inactivity may