厚生労働科学研究費補助金

循環器疾患・糖尿病等生活習慣病対策総合研究事業

社会経済格差による生活習慣課題への対応方策立案に向けた社会福祉・疫学的研究

（H30-循環器等--一般-004）

令和元年度　総括・分担研究報告書

令和２年（2020）年３月

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（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
総括研究報告書

社会経済格差による生活習慣課題への対応方策立案に向けた社会福祉・疫学的研究

研究代表者　近藤克則（国立長寿医療研究センター老年学評価研究部・部長）

研究要旨

【目的】社会経済的に不利な集団など生活背景の違いに着目し、A.食生活、運動、歯・口腔などの生活習慣や社会参加などの状況との関連要因を解明し、B.健康格差を「見える化」し、C.介入策を検討することを目的とした。

【方法】壮年と高齢者の二つのデータを用い分析を進め、InstantAtlas®を用いた「見える化」をし、神戸市職員も交えた研究班会議で介入策を検討した。

【結果】A. 関連要因の解明　1）壮年データ分析では、行政区間で歯科口腔保健状態に差があり（研究協力者:山本・朱)、食生活や運動習慣、喫煙などの生活習慣や健診受診などの健康行動はサードプレイスがある者で良い傾向があり、スポーツクラブ参加者において健康指標が良好であった（研究協力者:山口・渡邉)。関連要因には、教育歴、所得、就職氷河期世代の女性において就業の有無による違いがうかがえ（佐々木、研究協力者:朱)、行動変容ステージ、サードプレイスとの関連が見られた（斉藤、村田、研究協力者:相田)。2）高齢者データ分析では、入れ歯の手入れをしないことが肺炎のリスク（Kusama)、メタボリック症候群と BMI との組み合わせ（Yokomichi）や膝痛(Yamada)が認知症リスク､その膝痛は歩きやすさ（Okabe）と、要介護認定も食料品へのアクセス（Momosaki）など建造環境が重要であること、社会参加している人で機能低下が少なく（Ide)、社会参加が増えた市町村でうつ割合が減ったこと（Watanabe)、小児期の貧困がスポーツの会参加を阻害しており（Yamakita)、教育歴が短いことが認知症リスクであること（Takasugi）などライフコースの重要性を明らかにした。また神戸市の予算を主な財源として高齢者調査 2019 を行った。**B.「見える化」システムの開発**　若年対象の「市民の健康とくらしの調査」と高齢者を対象とした「健康とくらしの調査」において関連が認められた、または先行研究から重要と思われる指標を作成して、行政区別、あんしんすこやかセンター圏域別の「見える化」システムを開発した。神戸市からの要望も受け、システムを改良し、健康指標が思わしくない区を明らかにした（研究協力者：辻)。**C. 介入策の検討**　健康格差の縮小に向けた介入策としては、上述した建造環境やライフコースが重要と思われるが介入が難しい。そのため、壮年層に対して、神戸市が開発した健康アプリ My Condition Kobe（MCK）の利用促進を図り、行動変容を支援し、社会階層間、行政区間で登録者数の変化などプロセス評価をしていくこととした。高齢者については、数年前からの介入の（中間）アウトカム評価を進めている。

【結論】社会経済的に不利な集団の食生活、運動、歯・口腔などの生活習慣や社会参加などの状況には､壮年でも高齢者でも多くの社会的な要因が関連していることが解明できた。健康格差を「見える化」し、介入策を検討し立案できた。

Ａ．研究目的

社会経済的に不利な集団や建造環境の違いなど生活背景・環境の違いに着目し、1.食生活、運動、歯・口腔、健診受診などの生活習慣や社会参加や社会的サポートなどの生活状況との関連要因を解明し、2.健康格差を「見える化」し、3.介入策を検討することを目的とした。

Ｂ．研究方法

1.関連要因の解明は、壮年と高齢者の二つのデータを用い分析を進めた。壮年データは、神戸市在住 20-64 歳の 20,000 名に自記式郵送調査法にてアンケートを行い，回答を 6,666 名から得た。このうち同意を得られたデータのみ研究に用いた。対象や方法は、論文や報告毎に異なるため、結果のところに記述する。2．健康格差の「見える化」については、Web-GIS（地理情報システム）InstantAtlas®を用いた「見える化」システムを開発した。3．介入策の検討では、神戸市職員も交えた研究班会議で介入策を検討した。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

Ｃ．研究結果

1．関連要因の解明

壮年データの分析と高齢者データの分析の順に述べる。

1）壮年データ

①歯科受診と口腔の健康に関する解析（山本龍生、持田悠貴、相田潤報告）

歯科疾患は、有病率が極めて高いため、健康の地域格差も大きい。そこで神戸市内の区ごとの歯科口腔保健状態の地域格差を明確化することを目的に分析を行った。区ごとの年齢ごとのクロス集計を行った。さらに「左右両方の奥歯でしっかりかみしめられる」の項目について探索的な解析を行った。その結果、長田区、兵庫区、北区などで、歯科口腔保健状態の悪い指標が多い傾向にあった。しっかりかめる者に関するロジスティックス回帰分析から、その個人差に対して、年齢の高さ、健康保険の種類、生活習慣やその他の歯科口腔保健状態の関連が明らかになった。神戸市の区による健康状態の差異が認められた。今後、さらなる解析により、格差の要因や傾向を明確にする解析が必要であろう。

②女性の就業状況と健康格差・野菜料理摂取・幸福度（佐々木一郎報告）

就労関連では、無職者の健康状態が悪いことを示す先行研究は多くあるが、同じ無職でも自発的に職に就いていないケースも少なくない専業主婦の健康状態に焦点を当てた研究は、十分な研究蓄積がない。本研究では、健康状態・野菜摂取等について、専業主婦と就

業女性、または非就業女性と就業女性の比較を行った。その結果、等価所得は、中高年の専業主婦層について、低所得の割合がやや高い。学歴は、中高年の専業主婦層と中高年の就業女性について、差はあまりみられない。中高年の専業主婦層は、野菜摂取の割合はむしろ高い。社会経済的要因(等価所得と教育)を調整した上で、50～64 歳の専業主婦の糖尿病リスクは顕著に高い。幸福度が高い割合は、就業なし女性のほうが就業あり女性よりも高い。

③がん検診受診状況と受診率向上に向けた取り組みの提案（山口知香枝、小嶋雅代報告）

本研究では，胃がん検診，肺がん検診，大腸がん検診，子宮がん検診，乳がん検診それぞれの検診の受診状況を健康保険の種別やサードプレイスの有無とともに明らかにし，多くの市民が積極的にがん検診を受診できるような機会を作るための示唆を得ることを目的とした。その結果，国民健康保険加入者の受診率が低く，さらに，女性では，サードプレイスの存在が検診受診行動と有意に関連していることが明らかとなった。今後の介入案としては，国民健康保険加入者が集いやすい場での情報提供を行うことなどが挙げられる。また，女性が気楽に集まれるサードプレイスの運営支援，参加の奨励と検診情報提供・各種検診の実施を行っていくことも有効ではないかと考える。

④就労子育て世代へのアプローチ（サードプレース関連要因の追加分析）（村田千代栄報告）

サードプレースは、自宅以外に居心地よく感じる場所であり、自宅と職場や学校の間を結び、非公式な出会いや、健康情報などのやり取りが生まれる場所である。これまで、神戸市では、健康教育事業への参加は全体の 1 割に満たなかった。そこで、就労子育て世代への関わり方の手がかりをえることを目的とした。対象は、20 歳から 40 歳の就労者で子どもと同居している回答者 835 名である。特にサードプレース「その他」の自由記載の分析では、全データ（N=6657）では、祖父母を含む親族宅をあげた人は 98 人（21.2%）に対し（昨年度の報告書参照）、40 歳以下の就労子育て世代の自由記載 47 件の分析では、51%と、祖父母を含む親族の割合が高かった。　一方、就労子育て世代の 6.8%（N=57）は一人親（死別・離別・未婚など）であり、サードプレースがあると回答した割合は若干多かった（配偶者ありの 25.4%に対し 26.3%）ものの、一人親ほど、K6 で 5 点以上が多く（配偶者ありの 30.3%に対し 51.8%）、喫煙者割合も 19%に対し 26.8%と健康指標が良好でなかった。また、低所得者（年間 200 万未満）の割合も高く（配偶者ありの 14.4%に対し 76.4%）、健康格差の是正には、一人親にターゲットを絞った介入の必要性が示唆された。

⑤社会参加と健康指標の関連および所得階層別の社会参加割合（渡邉良太、近藤克則報告）

地域在住高齢者を対象とした研究で社会参加が健康へ好影響をもたらすこと，通いの場サロンのような社会参加の場で低所得者層の参加が多いことが確認されている．しかし，青壮年期における社会参加と健康指標の関連，社会参加の種類と所得階層毎の参加割合に関する報告は少ない．そこで本研究の目的は、第 1 に健康指標へ好影響をもたらす社会参加の種類，第 2 に所得階層毎に社会参加の種類によって参加割合が異なるかを明らかにす

ることである．社会参加と健康指標の関連を明らかにするために，9 種類の健康指標を目的変数，10 種類の社会参加を説明変数とし，性・年齢・社会経済的要因を調整したロジスティック回帰分析を行った．次に 10 種類の社会参加の有無を目的変数，等価所得（200 万未満，200－399 万，400 万以上）を説明変数とし，性・年齢を調整したロジスティック回帰分析を行った．結果，スポーツグループへ参加者は非参加者に対し 7 種類の健康指標が有意に良好であることが示唆された．また社会参加の種類によって，等価所得 400 万以上や 200－399 万で参加が多い社会参加が存在することが明らかとなった．青壮年期においてもスポーツグループのような社会参加と健康指標が関連している可能性がある．今後は社会参加者増加の向けた研究が重要である．

2）高齢者データ

①入れ歯の手入れを毎日しないと過去 1 年間の肺炎のリスクが 1.3 倍高かった

Kusama T, Aida J, Yamamoto T, Kondo K, Osaka K. Infrequent Denture Cleaning Increased the Risk of Pneumonia among Community-dwelling Older Adults: A Population-based Cross-sectional Study. Sci Rep 2019; 9: 13734.

誤嚥性肺炎は高齢者の死因の上位を占めており、今まで誤嚥性肺炎予防のための口腔ケアが入院患者や介護施設入所者に対して実施され、その有効性が確認されてきた。しかし、入院や施設入居をしていない、地域在住の高齢者における口腔衛生と肺炎の関連についての研究報告はなかった。本研究では、65 歳以上の地域在住高齢者約 7 万人を対象に、入れ歯の清掃頻度が少ないことが過去 1 年間の肺炎の発症と関連するのかを明らかにすることを目的とした。その結果、入れ歯を毎日は清掃しない人において、過去 1 年間の肺炎発症のリスクが 1.30 倍、75 歳以上の人に限ると 1.58 倍高かった。入れ歯の清掃を毎日行うことによって、地域在住の高齢者においても肺炎の発症を予防できる可能性が示唆された。要介護状態にない人でも、入れ歯を使っている人は、手入れを毎日行うことが肺炎の予防につながる可能性があきらかとなった。世界で初めての一般高齢者における研究である。

②高齢者は痩せているほど認知症になりやすい ～糖尿病と並ぶ新たなリスクファクター～

Yokomichi H, Kondo K, Nagamine Y, Yamagata Z, Kondo N. Dementia risk by combinations of metabolic diseases and body mass index: Japan Gerontological Evaluation Cohort Study. Journal of Diabetes Investigation 2019. 2019 年 6 月 17 日号

糖尿病が認知症のリスクファクターであること、高齢期に痩せていることが平均寿命を縮めていることも分かってきました。痩せ体型は認知性リスクファクターか否かを検討した。JAGES（Japan Gerontological Evaluation Study：日本老年学的評価研究）の 3,696 人の高齢者コホートデータを分析した結果、338 人が認知症を発症した。糖尿病を持つ人は男性で 2.22 倍、女性で 2.00 倍、痩せていることは男性で 1.04 倍、女性で 1.72 倍認知症リスクが高かった。100 人・1 年あたりの認知症発症率は、高度肥満：0.99、肥満：1.11、標準体重：1.58、痩せ体型：2.92 だった。認知症発症率が最も高かったのは高血圧症を持つ痩せた人、次いで脂質異常症を持つ痩せた人であった。脂質異常症を持たない標

準体重の男性と比較して、脂質異常症を持つ痩せた男性は 4.15 倍、高血圧症を持たない標準体重の女性と比較して高血圧症を持つ痩せた女性 は 3.79 倍認知症リスクが高かった。

③65～79 歳で膝痛あると認知症発症リスク 1.7 倍 80 歳以上で腰痛あると認知症発症リスク 0.5 倍 ～地域高齢者 3 年間の観察研究～

Yamada K, et al. A prospective study of knee pain, low back pain, and risk of dementia: the JAGES project. Scientific Reports. 2019.9:10690.
https://www.nature.com/articles/s41598-019-47005-x

痛みと脳の働きは関連が深いが、痛みと認知症の関連についての過去の研究は結果が様々です。痛みのある体の部位が違えば原因も変わってくるので、膝痛と腰痛の有無で分類し、それぞれ３年以内の認知症発症との関連を調べた。対象の高齢者 14,627 名のうち 298 名が認知症を発症し、痛みがない人と比べて、65～79 歳で膝痛がある人は認知症の発症が 1.73 倍多く、反対に 80 歳以上で腰痛がある人は認知症の発症が半分であった。これは、この他に痛みや認知症に影響が大きい原因にてうい調整した結果である。さらに、膝の痛みは歩行への影響が大きいと考えられるため、毎日の歩行習慣も検討したところ、膝の痛みがあって、毎日 30 分以上の歩行習慣がないと、さらに認知症の発症率は高かった。

④ウォーカブルな歩きたくなるまちで ひざ痛は 15%少ない

Daichi Okabe, Taishi Tsuji, Masamichi Hanazato, Yasuhiro Miyaguni, Nao Asada, and Katsunori Kondo: Neighborhood Walkability in Relation to Knee and Low Back Pain in Older People: A Multilevel Cross-Sectional Study from the JAGES. Int. J. Environ. Res. Public Health 2019, 16(23), 4598.

足腰の痛みなどの筋骨格系疾患は健康寿命を短くする原因の 1/3 を占め、世界の 3 人～5 人に 1 人が抱える大きな課題である。対策として運動が効果的だと分かっているものの、運動不足は世界的に広がっている。一方で、街の歩きやすさを表すウォーカビリティは近年注目を浴びており、ウォーカビリティは運動と関連すると知られているが、痛みとの関連に注目した研究報告はほとんどない。そこで 30 市町村の高齢者約 2 万人を対象に、「近隣に運動 や散歩に適した公園がどのくらいあるか」などを尋ね「まったくない」～「たくさんある」の 4 段階で答えてもらった。その結果、１段階分「良い」と答える人が多くなると、ひざ痛を訴える人が 15%少ないという結果が得られた。「暮らしているだけで痛みが少ないまち」の条件の一つはウォーカブルであることが示唆された。

⑤近隣に食料品店がないと 要介護になるリスクが 1.2 倍高い

Momosaki R, Wakabayashi H, Maeda K, Shamoto H, Nishioka S, Kojima K, Tani Y, Suzuki N, Hanazato M, Kondo K. Association between Food Store Availability and the Incidence of Functional Disability among Community Dwelling Older Adults: Results from the Japanese Gerontological Evaluation Cohort Study. Nutrients. 2019;11(10).

食料品店へのアクセスの悪さが不適切な食生活につながる可能性については報告されている。しかし、食料品店へのアクセスの悪さが要介護状態への移行に影響するかどうかは報告がない。そこで本研究では、65 歳以上の高齢者 31,273 名を 6 年間追跡し、近くに野菜や果物を売っている店があるかどうかと要介護移行との関連性を調べた。その結果、近隣に食料品店が「たくさんある」「ある程度ある」と回答した人に比べ、「あまりない」「まったくない」と回答した人の要介護リスクは約 1.2 倍であった。高齢者では、近隣の食料品店へのアクセスの悪さが要介護リスクとなる可能性が示された。

⑥就労，スポーツ・趣味グループへの参加は都市でも農村でも要介護リスクを 10-24%抑制

Ide K, Tsuji T, Kanamori S, Jeong S, Nagamine Y, Kondo K. Social Participation and Functional Decline: A Comparative Study of Rural and Urban Older People, Using Japan Gerontological Evaluation Study LongitudinalData. Int. J. Environ. Res. Public Health 2020, 17(2), 617; https://doi.org/10.3390/ijerph17020617

高齢者の社会参加は要介護リスクを抑制することがわかっており、その効果はスポーツ、趣味の会など参加する組織の種類によって異なることが明らかとなっている。しかし、①高齢者雇用安定法などの改正案で着目されている “就労”、②参加割合が低い農村と参加割合が高い都市といった居住環境を考慮した分析はこれまで行われていない。全国 13 市町の高齢者を約 6 年間追跡したデータを分析し、就労を含む社会参加の種類別の要介護リスク抑制効果を農村・都市別で検証した。その結果、農村，都市ともに参加している組織の数が多いほど、要介護リスクが低いという関連がみられた。また、農村・都市ともに就労、スポーツ・趣味グループへの参加が要介護リスクを抑制していた。農村・都市ともに、スポーツ・趣味グループなどへの参加促進だけでなく、就労支援も重要な介護予防施策となりうる。

⑦社会参加 5 年間に 10%増加の市区町で地域全体の抑うつ割合 3%減少

Watanabe R, Kondo K, Saito T, Tsuji T, Hayashi T, Ikeda T, Takeda T. Change in Municipality-Level HealthRelated Social Capital and Depressive Symptoms: Ecological and 5-Year Repeated Cross-Sectional Study from the JAGES. International Journal of Environmental Research and Public Health. 2019;16(11):2038. PubMed PMID: doi:10.3390/ijerph16112038. URL：https://www.mdpi.com/1660-4601/16/11/2038

近年、社会参加を含む地域づくりが注目されている。これまでの研究で社会参加が多い地域で、その後の抑うつ者発生が少ないことが明らかになっていた。それでは、社会参加が盛んになった地域で抑うつ割合は減少するのだろうか。本研究では、5 年間のうちに社会参加割合の増加した地域で抑うつ割合が減少しているのかどうかを全国 44 市区町のデータを用い検証した。その結果、社会参加割合が増加した市区町で抑うつ割合が減少することが確認された。特にスポーツの会や趣味の会が 10%増加すると地域全体の抑うつ割合が 3%減少する傾向が明らかとなった。

⑧子どもの時の貧困は、高齢期のスポーツ参加にも関連する

～子どもの時に貧しかったと感じている男性で１８%、女性で１２%少ない～

Yamakita M, Kanamori S, Kondo N, Ashida T, Fujiwara T, Tsuji T, and Kondo K. Association between childhood socioeconomic position and sports group participation among Japanese older adults: a crosssectional study from the JAGES 2010 survey. Preventive Medicine Reports. 18: 101065. 2020.

子どもの頃の社会経済的地位が高齢期の死亡率やうつ病、認知症の発症など多くの健康指標に影響することが示されているが、スポーツに参加する、しないという行動にも影響するのだろうか？要介護認定を受けていない65歳以上の日本の高齢者22,311人について調べたところ、子どもの頃の社会経済的地位が低かった人（貧しかったと感じている人）は、高かった人に比べてスポーツへの参加が男性で１８%、女性で１２%少なく、子どもの頃の社会経済的地位は高齢期のスポーツ参加にまで影響する可能性が示された。また、教育を受けた期間を考慮するとその影響は小さくなり、子どもの頃の貧困の影響を教育によって緩和できる可能性が示されました。

⑨認知症リスクは教育年数 6 年未満で男性 34%、女性 21%増～所得・最長職に比べ教育年数が最も強い関連～

Takasugi T, Tsuji T, Nagamine Y, Miyaguni Y, Kondo K. Socio-economic status and dementia onset among older Japanese: A 6-year prospective cohort study from the Japan Gerontological Evaluation Study. International Journal of Geriatric Psychiatry. 2019;34:1642-1650. https://doi.org/10.1002/gps.5177

教育年数、所得、最長職という3つの社会経済的な因子と高齢者の認知症リスクとの関連を調べた。65歳以上の高齢者52,063人を対象に、約6年間追跡し認知機能低下の状況を調査したところ、対象者の10.5%（5,490人）に認知機能低下が確認されました。教育年数「13年以上」に比べ「6年未満」で、認知症リスクが男性では34%、女性では21%高くなることが確認された。この関連性は、所得、最長職と認知症リスクの関連性と比較して相対的に強いことが示された。認知症予防には、成人・高齢期の社会経済状況を支援するだけではなく、子ども期の教育機会の担保が極めて重要だと考えられる。

2.「見える化」システムの開発

データ分析で関連が認められた、または先行研究から重要と思われる指標を作成して、行政区別、あんしんすこやかセンター圏域別の「見える化」システムを開発した（図 1，2 参照）。神戸市からの要望も受け、システムを改良し、健康指標が思わしくない区を明らかにした（辻報告）。若年対象の「市民の健康とくらしの調査」と高齢者を対象とした「健康とくらしの調査」データを用いた、それぞれの「見える化」システムを用いて指標間の関連を分析し、共通点と相違点を明らかにした（斉藤報告）。

人工知能を用いたシミュレータ開発を当初計画していたが、そのために必要なクラウド接続しての分析もデータ持ち出しも神戸市に認められず断念せざるを得なかった。

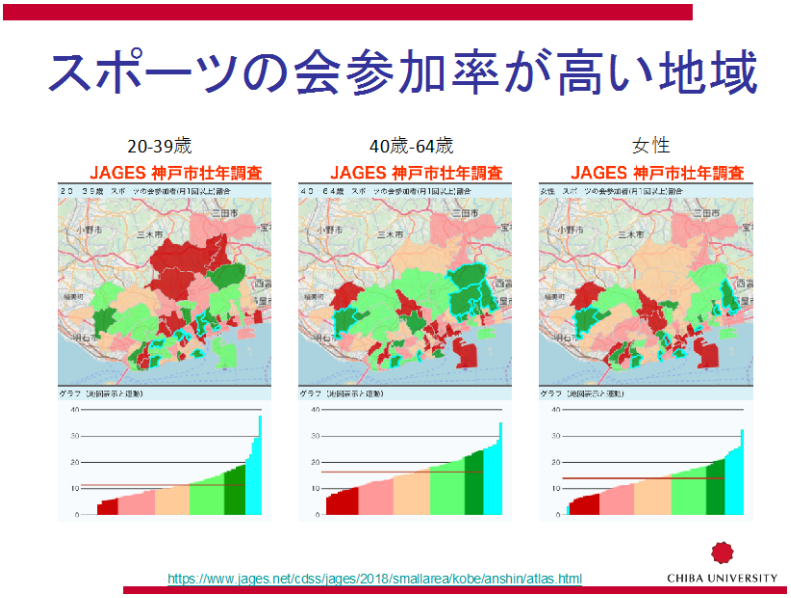

図 1　「見える化」システムの画面例：地域診断書から抜粋して合成

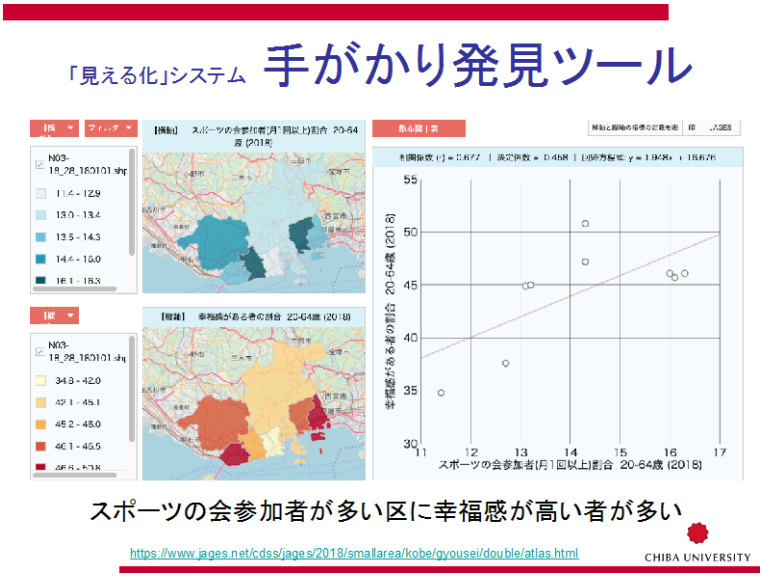

図 2　「見える化」システムの画面例：手がかり発見ツール

①神戸市における年代別の地域間健康格差の実態把握および格差が大きい指標の抽出（辻大士報告）

本研究では、神戸市の 9 行政区間の健康格差の現状を年代ごとに記述（見える化）し、成人層（20～64 歳）と高齢層（65 歳以上）との間で格差が固定化されている地域・指標と、年代間で格差の様子が異なる地域・指標とをそれぞれ明らかにすることを第一の目的とした。また、成人層のデータを基に、行政区間の格差が大きい指標を抽出することを第二の目的とした。成人層は 6,584 人、高齢層は 10,040 人を分析対象とした。不利な状況が年代を越えて固定化されている地域・指標が見つかった一方、高齢層と比較して成人層で状況が好転している地域・指標や、逆に成人層で悪化している地域・指標も見つかった。例えば主観的健康感に着目すると、B 区の男性は年代を問わず不良者が多かったが、別の I 区では若年層でのみ、さらに別の H 区では高齢層ほど不良者が多いなど、地域と指標によって格差の様相は異なっていた。また、成人層の各年代に共通して格差が大きい指標として、独居者割合、低所得者割合、低学歴者割合、経済的に苦しい者の割合などの社会経済的な指標が確認された。このような現状を把握した上で、健康格差の是正に向けた中長期的な対策を検討することが肝要であろう。

②若年層における健康格差の見える化にむけた地域診断システムの可能性（斉藤 雅茂報告）

本研究では、兵庫県A市における若年層（20 歳以上 65 歳未満）対象調査データを活用し、若年層における健康格差の見える化にむけた地域診断システムの可能性を検討した。過去に開発した高齢者の健康格差の見える化を目的にした「JAGES 地域診断システム」をプラットフォームとし、若年層調査データを追加した。分析の結果、若年層においても、「友人 10 人以上」、「友人と会う頻度」、「趣味」、「スポーツ」、「学習・教養サークル」などといった他者との交流に「健康格差縮小」の可能性があることが示唆された。高齢者との比較では、多くの指標で年齢層を問わず同様の関連を示したが、高齢者よりも若年層で幸福や健康との関連がより強く示される指標も目立った。「喫煙」や「口腔機能低下」、「健診未受診」は、若年層においても幸福や健康を阻害するリスクがあることが示唆された。若年層と高齢者で異なった指標として、「地域活動参加意向」は、若年層のみで幸福感、健康度自己評価と正の相関があった。また、「独居者」、「孤食者」については、幸福は若年層と高齢者で同傾向だが、健康は若年層では相関がなく、「孤食」や「独居」の健康への影響は年齢層で異なることが示唆された。以上のことから、若年層でも地区単位での差（分散）が確認され、年齢層によるいくつかの相違に留意する必要はあるものの、若年層においても高齢者と同様に、データに基づく地域診断によって健康格差を見える化することの有用性が示された。

3. 介入策の検討

健康格差の縮小に向けた介入策としては、上述した建造環境やライフコースが重要と思われるが介入が難しい。そのため、壮年層に対して、神戸市が開発した健康アプリ My Condition Kobe（MCK、図 3 参照）の利用促進を図り、行動変容を支援し、社会階層間、行政区間で登録者数の変化などプロセス評価をしていくこととした。高齢者については、数年前からの介入の（中間）アウトカム評価を進めている。

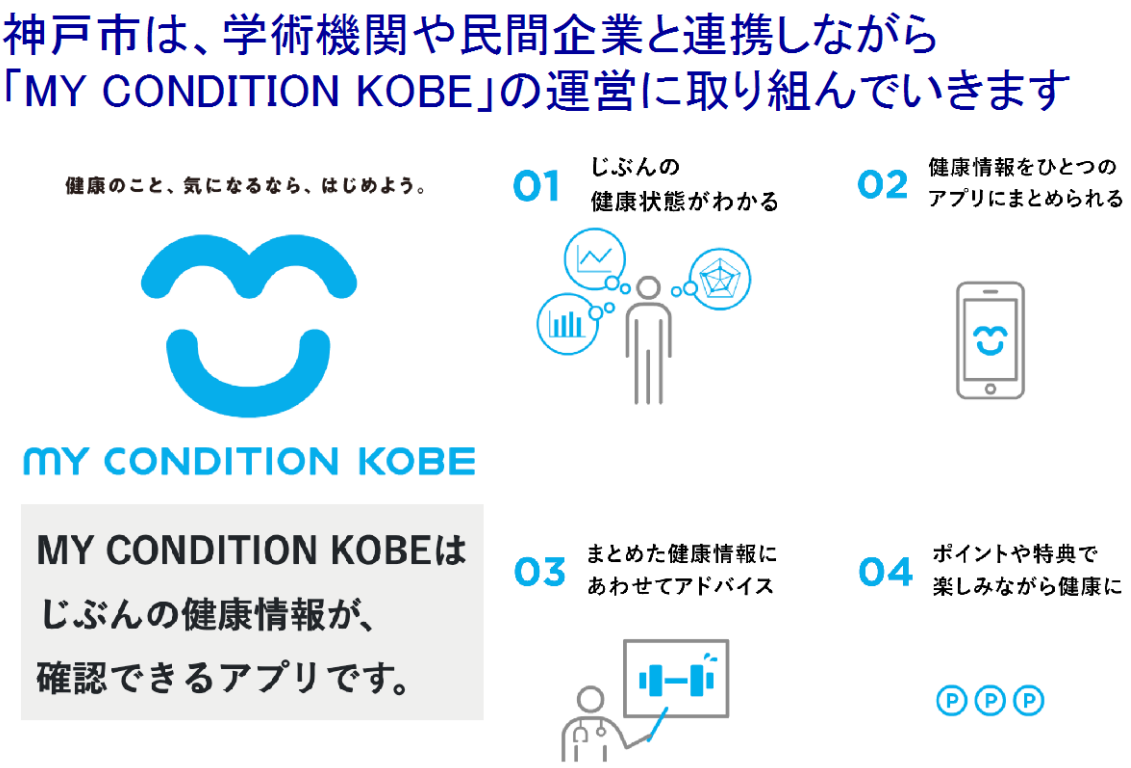

図 3　My Condition Kobe（MCK）の説明：神戸市のホームページから抜粋

1）MCK 登録者の特徴（健康政策課による分析）

行動変容をもたらす介入策として、My Condition Kobe (MCK) への登録を促す介入を用いて、どのような人がどれくらいの割合で行動変容するのかを評価することを目的とした。その第一歩として、MCK の登録者の特徴を記述することを目的とした。

若年対象の「市民の健康とくらしの調査」回答者 6666 人に MCK の登録案内を送ったところ、303 人（4.6%）が MCK に追加登録した。最初に調査票を送った 2 万人を分母にしても約 1.5%で、これを 2019 年 10 月現在の MCK の全登録者約 4700 人と比べると、神戸市民（20-64 歳）が約 70 万人とすると約 0.7%よりも 2 倍多く、事前に調査票に回答すること、あるいは回答者の意識は高く、登録率が高い可能性が示された。調査データと結合して分析した結果，無関心期約 4%、関心期約 5%、実行期約 7%と行動変容ステージが進むにつれて登録が増えていることが判明した。

参加登録数を伸ばすためには、市が行う各種調査の中で行動変容ステージを評価して、関心

から実行期の人にMCK案内状を送ると、登録数が7～10倍に増える可能性が示唆された。また地域別に分析すると、健康状態が悪い地域（区）に、やや意外なことに関心期の人が多かったことから、規模を拡大できれば、健康格差の縮小に寄与しうる可能性が示唆された。

2）高齢者における地域介入の評価

2016年調査で閉じこもりが多いと判明した3地区を対象にした地域介入、地域支援事業の2018年度までに収集したデータを用いて評価をしたが、期待した効果が示されなかったため、2019年度に行った調査データを用いて、観察期間をもう1年延ばした評価結果に期待したい。

D．考察

1.関連要因の解明では、壮年データでも高齢者データでも、小さくない健康格差が見られること、その緩和要因として、サードプレースや社会参加（中でもスポーツの会）、社会サポートなど健康の社会的決定要因が共通していること、一方で孤食の関連は高齢者においてのみ見られることなどが明らかになった。このような壮年と高齢期での違いに留意しつつも、回収率が壮年では、3割に留まることから、回収率が7割の高齢者データで得られる知見の援用も考慮すべきと思われた。

高齢者データを用いた分析では、個人レベルでも、市町村レベルでも、社会参加が健康に保護的な効果がみられたことから、社会参加を促す政策には効果が期待できること、歩きやすさや食料品へのアクセスなど建造環境が重要であること、小児期の貧困や教育歴などライフコースの重要性が明らかになった。短期的には介入が難しいが、健康無関心層にも届く、あるいは無関心層を生まない政策という意味で、長期的・大局的には、建造環境やライフコースを改善する政策も健康格差対策をめざす政策として考慮すべきと考えられた。

2.「見える化」システムの開発では、壮年データでも、明らかな地域間格差があり、格差が大きな指標では2倍以上であった。その関連要因には高齢者と似た要因があることが確認できた。医師、歯科医からも、これほどの格差が市内にあることへのコメントも聞かれ、関係者で健康格差問題を共有する上での「見える化」システムの意義を確認できた。

3. 介入策の検討では、上述した建造環境やライフコースが重要と思われるが,介入が短期的には難しいため、壮年層に対する行動変容から着手することとした。神戸市が開発した健康アプリMy Condition Kobe（MCK）の利用促進を図り、健康状態が悪い地域でやや多かった関心層に登録を勧奨して行動変容を支援して、社会階層間、行政区間の登録者数格差を減少させる可能性は感じられた。一方で、調査と別に勧奨案内をすると、総量のコストが二重にかかるなど、コスト面からの施策の妥当性の評価も必要との指摘があった。高齢者については、数年前から社会参加を促す介入を進めており、来年度にまとまる（中間）アウトカム評価の結果に期待したい。

E．結論

社会経済的に不利な集団の食生活、運動、歯・口腔などの生活習慣や社会参加などの状況には、壮年でも高齢者でも、地域間、集団間に格差が見られること、それには多くの社会的な要因が関連していることが解明できた。健康格差を「見える化」し、介入策を検討し立案し、一部施行で

きた。

F．健康危険情報

特になし

G. 研究発表

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2. 学会発表

なし

（発表誌名巻号・頁・発行年等も記入）

H. 知的財産権の出願・登録状況

（予定を含む。）

1. 特許取得

なし

2. 実用新案登録

なし

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

歯科受診と口腔の健康に関する解析

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研究要旨

健康格差の縮小が公衆衛生上の課題となっている。歯科疾患は、有病率が極めて高いため、健康の地域格差も大きい。そこで神戸市内の区ごとの歯科口腔保健状態の地域格差を明確化することを目的に分析を行った。

区ごとの年齢ごとのクロス集計を行った。さらに「左右両方の奥歯でしっかりかみしめられる」の項目について探索的な解析を行った。

長田区、兵庫区、北区などで、歯科口腔保健状態の悪い指標が多い傾向にあった。しっかりかめる者に関するロジスティックス回帰分析から、その個人差に対して、年齢の高さ、健康保険の種類、生活習慣やその他の歯科口腔保健状態の関連が明らかになった。

神戸市の区による健康状態の差異が認められた。今後、さらなる解析により、格差の要因や傾向を明確にする解析が必要であろう。

A．研究目的

健康格差の縮小が重要な公衆衛生上の課題となっている。健康格差は社会経済要因などの健康の社会的決定要因の分布によって健康状態が異なることが主要な原因で発生する。そのため、地域ごとの健康状態の差異として現れることが多く、行政の施策としては健康状態の地域格差の解消が実際的な目標として用いられることが多い。歯科疾患は、有病率が他の疾患に比べて極めて高いため、健康状態の地域格差も大きく存在することが知られている（1）。そこで本研究では、健康格差のモニタリングにも資するよう、神戸市内の区ごとの歯科口腔保健の実態を明確にするための解析を行った。

B. 方法

神戸市に在住の 20-64 歳の成人 20,000 名に自記式郵送調査法にてアンケートを実施した。

歯数の質問（問 29）をはじめ、口腔関連の問 29～32 について分析を行った。問 31 のイ、ウ、エについては、別々の項目に加えて、該当項目が 2 項目以上あると口腔機能低下と定義した場合についての分析も実施した。年齢層は 10 歳刻みに層化し、性別を分けての分析も行った。

結果の表に関しては、各指標について、赤のセルに赤字は上位 33%、緑のセルに緑字は下位 33%というように色分けした。なお、全年齢合計のところには、この色分けは行わなかった。また、地域差の経済的な背景の理解に資するため、区別の等価所得の分布も分析した。さらに、歯科保健関係の全指標について、全年齢における男女合計の区の比較を「範囲（レンジ）」として、最大

値から最小値を除した値を計算した。

歯科口腔保健関係の指標の中で、行政区間で格差の最も大きかったのは、「左右両方の奥歯でしっかりかみしめられる」であったので、その項目と、各指標との関係をクロス表および$\chi 2$検定で検討した。また、「左右両方の奥歯でしっかりかみしめられる」の回答「いいえ」を1、「はい」を0として目的変数とし、その他の指標でクロス表の$\chi 2$検定において有意（$p<0.05$）であった指標を説明変数として投入し、ロジスティック回帰分析（変数減少法）を行った。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGESプロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C. 結果

表1に、男女全体の集計結果を示す。歯数20本未満の割合では、長田区、兵庫区、北区において数値が高い年齢層が複数あった。この傾向は、男女に分けても同様であった。

歯間部清掃具非使用者の割合は、須磨区、長田区、兵庫区、北区で数値が高い年齢層が複数あった。この傾向は女性では同様であったが、男性では東灘区、灘区において数値が高い年齢層が複数あった。

ゆっくりよくかんで食事をしない者の割合は、男女合計では長田区、兵庫区、北区において数値が高い年齢層が複数あった。男性では垂水区と兵庫区、女性では中央区と灘区において数値の高い年齢層が複数見られた。

半年前に比べて固いものが食べにくくなった者の割合は、男女合計では中央区、長田区、灘区において値が高い年齢層が複数あった。男性では中央区と長田区、女性では中央区、灘区、兵庫区において数値の高い年齢層が複数あった。

お茶や汁物等でむせることがある者の割合は、男女合計では須磨区、長田区、兵庫区、北区において数値の高い年齢層が複数あった。男性では長田区、東灘区、北区、女性では須磨区、西区、長田区において数値の高い年齢層が複数あった。

口の渇きが気になる者の割合は、男女合計では兵庫区において数値の高い年齢層が複数あった。男性では兵庫区と北区、女性では長田区、東灘区、兵庫区において数値の高い年齢層が複数あった。

左右両方の奥歯でしっかりかみしめられない者の割合は、男女合計では垂水区、長田区、兵庫区において数値の高い年齢層が複数あった。男性では長田区、灘区、兵庫区、女性では長田区、兵庫区、北区において数値の高い年齢層が複数あった。

口腔機能低下者割合は、男女合計では須磨区、垂水区、兵庫区、北区において数値の高い年齢層が複数あった。男性では男女合計と同様の傾向であった。女性では中央区、長田区、東灘区、兵庫区において数値の高い年齢層が複数あった。

この1年間における歯科検診未受診者の割合は、男女合計では須磨区、中央区、長田区、東灘区において数値の高い年齢層が複数あった。男性では須磨区、中央区、長田区、女性では垂水区、

中央区、長田区において数値の高い年齢層が複数あった。

以上の、全ての歯科保健関係の指標において、性別、年齢層別に検討した場合、表において全く赤のセルに赤字のなかった区は存在しなかった。

等価所得は、199 万円以下の者の割合は長田区と兵庫区に多く、400 万円以上の者の割合は中央区と東灘区に多かった。

歯科保健関係の全指標において、全年齢における男女合計の区の比較を「範囲（レンジ)」として計算したところ、最も大きかったのは、「左右両方の奥歯でしっかりかみしめられない」者の割合で 8.6%であり、東灘区が 21.5%と最低であったのに対して、長田区では 30.1%と最も高かった。次いで、「半年前に比べて固いものが食べにくくなった」者の割合で 7.7%であった。

「左右両方の奥歯でしっかりかみしめられる」の有無と各指標との関係についてクロス集計を行った結果を表 2 に示した。住宅の種類、歯間部清掃具使用頻度、この 1 年間の歯科検診を除いた全ての変数において、有意な関係が見られた。

有意な変数を投入してロジスティック回帰分析を行った結果を表 3 に示した。高齢、2 人または 5 人以上で暮らしていること、国民健康保険、誰かと一緒に食事する機会が週に何度かまたはほとんどないこと、野菜料理を食べる頻度が週 4～5 日、主食・主菜・副菜を食べる頻度が週に 2～3 回、喫煙していること、歯数が 19 本以下であること、ゆっくりよくかんで食事をしないこと、固いものが食べにくくなったこと、口の渇きが気になることと、それぞれ有意な関連が見られた。

D. 考察

区ごとのクロス集計により、神戸市の成人の口腔の健康状態に区による地域格差が認められた。兵庫区や長田区や北区などなど、状況が悪い項目が多い地区がある傾向が認められた。しっかりかめる者に関するロジスティックス回帰分析から、その個人差に対して、年齢の高さ、健康保険の種類、生活習慣やその他の歯科口腔保健状態の関連が明らかになった。

今回は探索的な解析をステップワイズ法を用いて行ったが、今後の解析の方針として、地域を固定効果として、①年齢や性別、②社会経済要因、③生活習慣要因、④歯科口腔保健状態について、それぞればらばらに投入したモデル、①とそれ以外を投入したモデル、すべてを投入したモデルを構築し、地域差に寄与する要因について検討が必要であろう。この方法は、特定の地区に特徴的な要因を明らかにしやすいと考えられる。また、固定効果で傾向が明確に認められない場合は、地域をランダム効果にしたマルチレベル分析で同様に解析を行い、ランダム効果の変化を検討していく方法がある。この方法は、地域差全体に影響する要因を明らかにしやすいと考えられる。また、健康格差のモニタリングを目的として（2)、どの地区が最も状態が悪いかを統計学的に明確にするような方向性の解析も考えられる。

E. 結論

神戸市の区による健康状態の差異が認められた。今後、さらなる解析により、格差の要因や傾向を明確にする解析が必要であろう。

Ｆ．研究発表

1. 論文発表

なし

2. 学会発表

なし

Ｇ．知的財産権の出願・登録状況

（予定を含む.）

1. 特許取得

なし

2. 実用新案登録

なし

H. 参考文献

（1）相田潤： 鉱山のカナリアとしての歯科疾患の健康格差：未処置う蝕は日本に４０００万人. 日本歯科医師会雑誌　72:43-51,2019.

（2）近藤尚己： 地域診断のための健康格差指標の検討とその活用. 医療と社会　24:47-55,2014.

表１．区ごとの歯科口腔保健状態の、年齢とのクロス集計

問29　歯数20本未満の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	24.4%	11.0%	20.7%	17.5%	28.6%	8.8%	14.6%	27.8%	9.1%
50歳代	6.3%	4.9%	4.3%	9.0%	11.3%	5.6%	8.1%	21.3%	8.6%
40歳代	1.3%	1.9%	2.4%	1.5%	5.1%	1.2%	1.7%	4.3%	5.2%
30歳代	0.8%	0.5%	1.8%	0.0%	4.5%	0.0%	0.8%	1.9%	0.6%
20歳代	0.0%	0.0%	0.5%	0.7%	0.0%	1.7%	0.0%	0.0%	1.2%
合計	5.2%	2.9%	4.5%	3.3%	8.2%	2.8%	3.7%	8.5%	5.3%

歯数20本未満の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	28.2%	12.2%	23.0%	27.3%	41.7%	9.5%	5.9%	44.4%	6.0%
50歳代	11.9%	9.3%	7.8%	11.1%	9.1%	8.0%	6.4%	30.3%	17.4%
40歳代	1.3%	3.9%	2.2%	0.0%	2.8%	3.1%	2.9%	6.5%	5.5%
30歳代	0.0%	1.3%	2.9%	0.0%	6.7%	0.0%	0.0%	0.0%	1.7%
20歳代	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
合計	6.9%	5.1%	6.0%	4.6%	10.9%	4.6%	2.8%	11.8%	7.3%

歯数20本未満の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	20.5%	9.8%	18.0%	5.6%	11.1%	7.9%	20.8%	11.1%	12.2%
50歳代	2.4%	1.9%	2.4%	7.5%	12.2%	3.4%	9.1%	14.9%	1.8%
40歳代	1.3%	0.6%	2.6%	2.6%	7.1%	0.0%	1.0%	2.9%	5.0%
30歳代	1.4%	0.0%	0.8%	0.0%	2.8%	0.0%	1.2%	3.6%	0.0%
20歳代	0.0%	0.0%	0.8%	1.1%	0.0%	1.0%	0.0%	0.0%	2.0%
合計	3.8%	1.4%	3.4%	2.5%	6.3%	1.5%	4.2%	5.7%	3.8%

問30　歯間部清掃具非使用者（4.使用していない者）の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	38.8%	32.0%	29.7%	40.5%	26.7%	39.5%	34.1%	48.7%	42.9%
50歳代	42.4%	34.9%	32.3%	35.1%	35.9%	39.7%	42.6%	38.6%	40.9%
40歳代	49.1%	41.1%	40.5%	42.1%	51.8%	36.2%	43.0%	45.3%	40.4%
30歳代	48.5%	43.2%	45.3%	40.8%	61.4%	43.8%	45.3%	45.0%	45.5%
20歳代	52.5%	63.5%	65.6%	56.2%	62.3%	62.0%	57.3%	70.0%	66.5%
合計	46.9%	43.5%	43.5%	44.2%	48.9%	43.7%	45.3%	49.0%	46.9%

歯間部清掃具非使用者（4.使用していない者）の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	51.2%	36.5%	41.5%	50.0%	30.8%	59.5%	35.3%	60.0%	50.9%
50歳代	54.1%	46.3%	38.7%	44.7%	44.0%	51.5%	58.8%	51.5%	41.1%
40歳代	60.5%	54.6%	50.5%	50.8%	67.6%	46.5%	60.0%	58.7%	52.6%
30歳代	66.1%	57.1%	51.4%	63.2%	59.4%	62.7%	66.7%	46.2%	61.9%
20歳代	48.9%	63.9%	72.2%	59.2%	74.1%	75.0%	61.3%	69.2%	73.1%
合計	56.9%	52.8%	51.3%	54.8%	56.5%	57.9%	59.5%	56.5%	54.7%

歯間部清掃具非使用者（4.使用していない者）の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	25.6%	27.5%	15.1%	27.8%	21.1%	17.9%	33.3%	36.8%	34.6%
50歳代	34.1%	27.0%	28.9%	28.6%	32.1%	30.2%	32.9%	30.0%	40.7%
40歳代	37.8%	32.3%	34.4%	35.8%	39.1%	30.0%	32.1%	36.6%	31.5%
30歳代	35.9%	35.9%	40.3%	26.7%	63.2%	31.6%	33.0%	44.1%	36.3%
20歳代	54.9%	63.2%	61.1%	54.5%	54.8%	52.8%	55.6%	70.7%	62.3%
合計	38.7%	37.3%	38.1%	37.0%	43.3%	33.7%	37.2%	42.9%	41.3%

問31ア　ゆっくりよくかんで食事をする(2.いいえ)の者の割合(男女合計)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	54.4%	57.8%	61.5%	48.8%	53.3%	56.8%	59.5%	69.2%	69.9%
50歳代	63.9%	60.1%	59.1%	62.1%	64.5%	60.6%	60.7%	67.9%	57.2%
40歳代	65.6%	63.3%	64.7%	56.7%	60.2%	61.0%	63.5%	68.4%	66.2%
30歳代	60.9%	64.0%	63.8%	63.9%	64.3%	59.1%	66.4%	64.0%	60.9%
20歳代	41.9%	55.1%	48.6%	58.4%	55.1%	49.5%	51.0%	45.0%	48.8%
合計	58.5%	60.8%	59.5%	59.6%	59.5%	57.8%	61.1%	62.9%	60.0%

ゆっくりよくかんで食事をする(2.いいえ)の者の割合(男性)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	58.5%	59.6%	71.9%	41.7%	61.5%	64.3%	47.1%	73.7%	69.2%
50歳代	70.0%	64.1%	67.4%	69.2%	64.0%	67.3%	66.0%	87.5%	60.7%
40歳代	75.3%	70.4%	75.5%	63.3%	62.2%	69.0%	65.7%	80.9%	76.0%
30歳代	66.7%	72.7%	69.5%	58.9%	71.9%	59.0%	74.0%	69.2%	71.7%
20歳代	39.6%	70.8%	54.9%	67.3%	77.8%	57.9%	54.8%	51.3%	53.8%
合計	64.0%	68.3%	67.8%	62.0%	67.3%	63.8%	64.7%	72.1%	66.5%

ゆっくりよくかんで食事をする(2.いいえ)の者の割合(女性)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	50.0%	56.0%	49.1%	58.8%	42.1%	48.7%	68.0%	65.0%	70.6%
50歳代	60.2%	57.4%	54.7%	57.1%	64.7%	55.2%	57.6%	55.1%	54.6%
40歳代	56.1%	58.7%	58.1%	51.9%	58.7%	56.2%	62.0%	60.0%	58.9%
30歳代	56.6%	59.3%	59.2%	67.0%	57.9%	58.8%	62.1%	59.3%	55.3%
20歳代	43.5%	44.3%	44.3%	53.4%	40.5%	43.5%	49.3%	39.0%	45.8%
合計	54.0%	55.9%	53.8%	57.9%	53.8%	53.6%	59.1%	55.6%	55.5%

問31イ　半年前に比べて固いものが食べにくくなった(1.はい)の者の割合(男女合計)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	25.3%	18.0%	22.0%	35.9%	32.6%	21.0%	22.0%	25.0%	23.8%
50歳代	12.3%	13.4%	12.6%	26.3%	19.7%	11.0%	15.7%	22.2%	17.4%
40歳代	6.1%	11.3%	8.1%	5.7%	15.7%	4.8%	11.4%	10.2%	7.1%
30歳代	5.3%	6.3%	5.5%	5.4%	5.7%	3.3%	6.5%	5.4%	5.7%
20歳代	4.3%	1.7%	3.2%	4.4%	4.3%	2.2%	2.9%	3.8%	3.4%
合計	9.4%	9.5%	9.2%	11.0%	14.5%	6.8%	10.8%	11.4%	10.9%

半年前に比べて固いものが食べにくくなった(1.はい)の者の割合(男性)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	26.8%	14.0%	24.6%	43.5%	44.0%	16.7%	12.5%	35.0%	22.6%
50歳代	13.1%	13.9%	14.3%	25.6%	20.0%	10.8%	8.2%	25.0%	18.2%
40歳代	6.3%	7.5%	7.1%	3.3%	13.5%	5.0%	13.0%	10.6%	5.2%
30歳代	5.4%	7.8%	2.8%	5.4%	6.3%	4.8%	3.9%	1.9%	3.2%
20歳代	8.5%	1.4%	0.0%	2.0%	7.4%	0.0%	3.2%	5.1%	6.0%
合計	10.8%	8.6%	8.6%	11.4%	17.1%	6.9%	8.3%	12.0%	11.1%

半年前に比べて固いものが食べにくくなった(1.はい)の者の割合(女性)

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	23.7%	22.0%	18.9%	25.0%	16.7%	25.6%	28.0%	15.0%	25.0%
50歳代	11.9%	13.0%	11.7%	26.8%	19.6%	11.2%	20.0%	20.4%	16.8%
40歳代	6.0%	13.7%	8.8%	7.4%	17.4%	4.7%	10.3%	9.9%	8.6%
30歳代	5.2%	5.5%	7.7%	5.5%	5.3%	2.3%	8.0%	8.5%	7.1%
20歳代	1.4%	1.9%	5.4%	5.7%	2.4%	3.7%	2.8%	2.4%	1.9%
合計	8.2%	10.1%	9.6%	10.8%	12.6%	6.8%	12.2%	10.8%	10.7%

問31ウ　お茶や汁物等でむせることがある（1.はい）の者の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	16.7%	18.8%	25.4%	20.0%	31.8%	25.0%	26.8%	15.4%	28.8%
50歳代	23.4%	20.6%	20.6%	16.1%	15.8%	18.1%	17.2%	19.8%	25.1%
40歳代	15.2%	13.9%	14.7%	14.9%	24.1%	10.7%	13.1%	17.1%	12.4%
30歳代	9.7%	9.9%	10.6%	10.2%	10.0%	12.1%	10.1%	13.5%	9.1%
20歳代	12.1%	7.9%	7.2%	8.0%	8.7%	11.4%	12.7%	6.3%	9.2%
合計	15.6%	13.7%	14.9%	12.7%	17.1%	14.0%	14.3%	14.5%	16.0%

お茶や汁物等でむせることがある（1.はい）の者の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	17.1%	20.0%	21.5%	17.4%	26.9%	23.8%	31.3%	10.5%	30.8%
50歳代	25.0%	20.3%	15.4%	18.9%	28.0%	10.8%	18.4%	18.8%	28.4%
40歳代	13.6%	11.3%	19.4%	15.0%	21.6%	11.0%	11.6%	19.1%	13.5%
30歳代	7.1%	11.7%	9.4%	12.5%	12.5%	16.9%	11.8%	13.5%	14.5%
20歳代	10.6%	5.6%	6.6%	2.0%	3.7%	10.5%	9.7%	10.3%	6.1%
合計	14.6%	13.3%	14.0%	12.4%	18.4%	13.4%	14.4%	14.7%	18.2%

お茶や汁物等でむせることがある（1.はい）の者の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	16.2%	17.6%	30.2%	23.5%	38.9%	26.3%	24.0%	20.0%	26.9%
50歳代	22.6%	20.9%	23.4%	14.3%	9.8%	24.0%	16.5%	20.4%	22.7%
40歳代	16.7%	15.5%	11.9%	14.8%	26.1%	10.6%	14.0%	15.7%	11.6%
30歳代	11.5%	9.0%	11.5%	8.8%	7.9%	9.2%	9.2%	13.6%	6.2%
20歳代	13.0%	9.4%	7.7%	11.4%	11.9%	12.0%	14.1%	2.4%	11.2%
合計	16.4%	13.9%	15.6%	12.8%	16.2%	14.4%	14.3%	14.2%	14.5%

問31エ　口の渇きが気になる（1.はい）の者の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	25.6%	19.0%	25.4%	22.5%	22.7%	24.7%	26.8%	22.5%	31.4%
50歳代	22.2%	22.7%	26.7%	23.4%	26.3%	22.5%	23.9%	30.9%	24.6%
40歳代	21.5%	23.0%	22.2%	22.7%	24.1%	18.9%	20.6%	31.6%	21.8%
30歳代	16.5%	25.2%	20.7%	23.3%	24.6%	15.4%	21.2%	27.9%	16.2%
20歳代	25.0%	19.8%	14.0%	17.5%	20.3%	23.4%	17.6%	16.3%	21.5%
合計	21.8%	22.3%	21.7%	21.9%	23.5%	20.2%	21.4%	26.7%	22.4%

口の渇きが気になる（1.はい）の者の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	19.5%	16.0%	29.2%	21.7%	19.2%	16.7%	18.8%	20.0%	22.6%
50歳代	16.7%	22.8%	24.2%	21.1%	16.0%	20.6%	22.4%	28.1%	26.1%
40歳代	22.5%	19.8%	22.7%	20.0%	24.3%	17.0%	20.3%	31.9%	22.9%
30歳代	12.5%	31.2%	18.7%	26.8%	19.4%	14.5%	24.0%	26.9%	26.7%
20歳代	29.8%	23.9%	14.3%	18.4%	14.8%	22.4%	6.5%	15.4%	24.6%
合計	19.9%	22.9%	21.3%	22.0%	19.2%	18.3%	19.5%	25.1%	24.5%

口の渇きが気になる（1.はい）の者の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	32.4%	22.0%	20.8%	23.5%	27.8%	33.3%	32.0%	25.0%	40.4%
50歳代	26.5%	22.6%	28.1%	25.0%	31.4%	24.0%	24.7%	32.7%	23.5%
40歳代	20.5%	25.0%	21.9%	24.7%	23.9%	20.0%	20.8%	31.4%	20.9%
30歳代	19.5%	22.1%	22.3%	21.1%	28.9%	16.2%	19.5%	28.8%	10.6%
20歳代	21.7%	17.0%	13.8%	17.0%	23.8%	24.1%	22.5%	17.1%	19.6%
合計	23.4%	22.0%	21.9%	21.9%	26.8%	21.5%	22.5%	28.0%	21.0%

問31オ　左右両方の奥歯でしっかりかみしめられる（2.いいえ）の者の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	42.3%	31.7%	48.3%	40.0%	52.3%	39.5%	43.9%	45.0%	37.1%
50歳代	30.6%	28.2%	28.8%	35.1%	42.9%	20.2%	29.9%	40.7%	30.4%
40歳代	19.5%	24.9%	26.0%	22.7%	23.2%	24.2%	26.7%	24.1%	27.2%
30歳代	17.3%	22.5%	18.7%	20.4%	30.0%	16.4%	17.5%	20.7%	13.3%
20歳代	17.1%	18.6%	16.7%	16.8%	11.6%	17.4%	18.4%	18.8%	17.4%
合計	24.1%	24.6%	25.8%	24.0%	30.1%	21.5%	25.1%	27.3%	24.9%

左右両方の奥歯でしっかりかみしめられる（2.いいえ）の者の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	48.8%	31.4%	50.0%	47.8%	61.5%	47.6%	50.0%	45.0%	32.1%
50歳代	36.7%	35.0%	30.4%	34.2%	48.0%	23.3%	26.0%	37.5%	35.2%
40歳代	26.3%	26.7%	30.6%	21.7%	27.8%	25.3%	34.8%	31.9%	25.0%
30歳代	14.3%	18.2%	17.0%	23.2%	34.4%	14.6%	20.0%	13.5%	11.5%
20歳代	23.4%	21.1%	16.5%	18.4%	11.1%	18.4%	16.1%	20.5%	10.8%
合計	28.7%	26.2%	27.3%	26.0%	35.6%	23.8%	27.8%	26.7%	24.2%

左右両方の奥歯でしっかりかみしめられる（2.いいえ）の者の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	35.1%	32.0%	46.3%	29.4%	38.9%	30.8%	40.0%	45.0%	42.3%
50歳代	26.5%	23.5%	27.9%	35.7%	40.4%	17.6%	32.1%	42.9%	26.9%
40歳代	13.1%	23.8%	23.1%	23.5%	19.6%	23.5%	21.5%	18.8%	28.9%
30歳代	19.5%	24.8%	20.2%	18.7%	26.3%	16.9%	16.1%	27.1%	14.3%
20歳代	12.9%	17.0%	16.9%	15.9%	11.9%	16.7%	19.4%	17.1%	21.5%
合計	20.4%	23.5%	24.7%	22.7%	26.1%	19.9%	23.5%	27.7%	25.5%

問31　項目イ、ウ、エの3つの中で該当項目（1.はい）2つ以上の者の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	21.8%	10.0%	17.8%	15.4%	16.3%	17.5%	17.1%	10.3%	26.9%
50歳代	11.8%	12.4%	13.4%	17.2%	14.5%	11.9%	14.9%	17.3%	17.4%
40歳代	6.7%	10.6%	9.3%	8.5%	19.3%	6.7%	8.6%	7.7%	6.7%
30歳代	6.1%	8.6%	7.6%	8.2%	7.2%	6.5%	6.6%	9.0%	6.4%
20歳代	7.8%	4.5%	4.1%	5.8%	5.8%	6.5%	5.9%	5.0%	5.2%
合計	9.7%	9.3%	9.8%	9.8%	12.5%	8.7%	9.8%	9.6%	11.4%

項目イ、ウ、エの3つの中で該当項目（1.はい）2つ以上の者の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	22.0%	12.0%	21.5%	17.4%	16.0%	11.9%	12.5%	10.5%	23.1%
50歳代	13.3%	11.4%	13.2%	16.2%	12.0%	8.8%	14.3%	18.8%	20.5%
40歳代	7.5%	9.4%	9.3%	6.7%	18.9%	7.0%	8.7%	8.5%	6.3%
30歳代	5.4%	9.1%	6.6%	8.9%	3.2%	8.4%	8.0%	5.8%	10.0%
20歳代	8.5%	4.2%	2.2%	2.0%	3.7%	3.9%	6.5%	7.7%	6.2%
合計	10.5%	9.1%	9.8%	8.8%	11.0%	7.7%	9.8%	9.5%	12.8%

項目イ、ウ、エの3つの中で該当項目（1.はい）2つ以上の者の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	21.6%	8.0%	13.2%	12.5%	16.7%	23.7%	20.0%	10.0%	30.8%
50歳代	10.8%	13.0%	13.5%	17.9%	15.7%	14.4%	15.3%	16.3%	15.1%
40歳代	6.0%	11.3%	9.4%	9.9%	19.6%	6.5%	8.5%	7.1%	7.0%
30歳代	6.6%	8.3%	8.5%	7.8%	10.5%	5.4%	5.7%	11.9%	4.4%
20歳代	7.2%	4.7%	5.4%	8.0%	7.1%	8.3%	5.6%	2.4%	4.7%
合計	9.1%	9.4%	9.9%	10.5%	13.6%	9.4%	9.8%	9.6%	10.3%

問32　この１年間に歯科検診を受けていない者の割合（男女合計）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	33.8%	32.0%	35.8%	42.9%	22.2%	28.0%	19.0%	38.5%	27.9%
50歳代	42.5%	36.2%	34.3%	29.5%	41.6%	43.2%	38.5%	42.2%	34.3%
40歳代	44.2%	38.0%	35.7%	46.5%	39.3%	39.9%	35.2%	36.4%	40.7%
30歳代	40.0%	41.9%	37.0%	35.8%	54.3%	43.3%	33.8%	43.2%	41.2%
20歳代	43.7%	49.2%	50.2%	46.0%	57.4%	46.7%	50.5%	45.0%	48.3%
合計	41.7%	40.0%	38.6%	40.4%	44.1%	41.5%	36.9%	41.0%	39.1%

この１年間に歯科検診を受けていない者の割合（男性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	46.3%	28.8%	44.6%	45.8%	26.9%	34.9%	17.6%	45.0%	30.8%
50歳代	54.1%	37.5%	37.6%	30.8%	50.0%	42.7%	48.0%	48.5%	38.9%
40歳代	46.9%	40.7%	36.7%	51.7%	39.5%	43.6%	37.1%	42.6%	43.3%
30歳代	43.9%	48.1%	40.7%	57.9%	65.6%	53.0%	45.1%	51.9%	49.2%
20歳代	45.8%	52.1%	57.6%	49.0%	57.7%	56.6%	61.3%	51.3%	55.9%
合計	47.6%	41.9%	43.2%	48.7%	47.9%	46.8%	43.4%	47.9%	43.5%

この１年間に歯科検診を受けていない者の割合（女性）

	須磨区	垂水区	西区	中央区	長田区	東灘区	灘区	兵庫区	北区
60歳代	20.5%	35.3%	25.5%	38.9%	15.8%	20.5%	20.0%	31.6%	25.0%
50歳代	34.5%	35.3%	32.6%	28.6%	37.7%	43.7%	32.9%	38.0%	30.8%
40歳代	41.7%	36.3%	35.0%	42.7%	39.1%	37.6%	33.9%	32.4%	38.8%
30歳代	37.2%	38.6%	33.8%	22.0%	44.7%	36.8%	27.3%	35.6%	36.8%
20歳代	42.3%	47.2%	45.0%	44.3%	57.1%	39.8%	45.8%	39.0%	43.4%
合計	36.9%	38.7%	35.4%	34.7%	41.3%	37.9%	33.2%	35.4%	36.0%

表２．左右両方の奥歯でしっかりかみしめられる者の割合についての各要因とのクロス集計

		左右両方の奥歯でしっかりかみしめられる				
		はい		いいえ		p
		人数	%	人数	%	（χ^2検定）
性	男	1,975	73.3	719	26.7	0.004
	女	2,942	76.5	905	23.5	
年齢	20歳代	1,045	82.7	219	17.3	<0.001
	30歳代	1,171	80.9	276	19.1	
	40歳代	1,293	75.5	420	24.5	
	50歳代	1,004	70.2	426	29.8	
	60歳代	384	58.8	269	41.2	
何人暮らし	1人	539	73.3	196	26.7	<0.001
	2人	1,059	70.3	448	29.7	
	3人	1,415	76.5	435	23.5	
	4人	1,398	78.8	375	21.2	
	5人以上	495	75.3	162	24.7	
等価所得	−199万円	901	68.2	421	31.8	<0.001
	200−399万円	1,859	74.9	622	25.1	
	400万円−	1,735	79.6	444	20.4	
健康保険	国民健康保険	1,380	72.3	529	27.7	<0.001
	全国健康保険協会管掌健康保険(協会けんぽ)	1,258	73.8	446	26.2	
	組合管掌健康保険(健康保険組合)	1,493	78.7	404	21.3	
	共済組合	556	80.3	136	19.7	
	その他	71	74.7	24	25.3	
	いずれも加入していない	49	51.0	47	49.0	
就業状況	勤め(常勤・正規職員)	2,476	76.9	743	23.1	0.016
	勤め(パート・アルバイト・非正規職員)	1,166	74.6	397	25.4	
	自営業・家業	252	72.2	97	27.8	
	内職・その他の就業形態	64	71.1	26	28.9	
	仕事をしていない	946	72.7	355	27.3	
住宅の種類	持家(一戸建て)	2,006	75.2	660	24.8	0.114
	持家(集合住宅)	1,447	76.8	438	23.2	
	公営賃貸住宅	220	69.0	99	31.0	
	民間賃貸住宅(一戸建て)	88	72.7	33	27.3	
	民間賃貸住宅(集合住宅)	918	74.7	311	25.3	
	借間	115	74.7	39	25.3	
	その他	83	72.2	32	27.8	
生活保護	受給していない	4,844	75.8	1,548	24.2	<0.001
	受給中（申請中を含む）	68	47.6	75	52.4	
教育歴	中学校卒（高校中退を含む）	131	57.7	96	42.3	<0.001
	高校卒（大学中退を含む）	1,143	67.6	547	32.4	
	専修・専門学校・短大・高専卒	1,294	75.8	412	24.2	
	大学卒	2,012	80.5	488	19.5	
	大学院卒	288	83.5	57	16.5	
	その他・不明	28	60.9	18	39.1	
生活習慣病	なし	4,258	76.8	1289	23.2	<0.001
	あり	661	66.2	338	33.8	
誰かと一緒に食事する機会	毎日ある	2,925	78.0	826	22.0	<0.001
	週に何度かある	1,053	73.5	379	26.5	
	月に何度かある	561	72.0	218	28.0	
	年に何度かある	228	70.2	97	29.8	
	ほとんどない	132	57.9	96	42.1	
野菜料理を食べる頻度	ほぼ毎日	2,984	78.2	833	21.8	<0.001
	週4～5日	1,055	73.7	377	26.3	
	週2～3日	766	69.4	338	30.6	
	ほとんどない	106	58.2	76	41.8	
清涼飲料水を飲む頻度	飲まない	1,102	76.0	348	24.0	0.018
	週に1～2回	1,469	76.6	449	23.4	
	週に3～4回	650	76.4	201	23.6	
	週に5～6回	407	75.5	132	24.5	
	毎日	1,280	72.2	494	27.8	
主食・主菜・副菜を食べる頻度	ほとんど毎日	2,269	77.4	662	22.6	<0.001
	週に4～5日	1,066	76.4	330	23.6	
	週に2～3日	1,054	70.6	439	29.4	
	ほとんどない	522	73.0	193	27.0	
喫煙習慣	喫煙している	688	66.1	353	33.9	<0.001
	喫煙なし	4,204	76.9	1,263	23.1	
飲酒習慣	問題飲酒なし	3,665	76.0	1,155	24.0	0.004
	女性のみ問題飲酒あり	669	75.1	222	24.9	
	男女問題飲酒あり	493	70.2	209	29.8	
友人・知人と会う頻度	週1回以上	1,259	77.2	372	22.8	<0.001
	月1～3回	1,736	77.3	510	22.7	
	年に数回	1,432	74.9	480	25.1	
	会っていない	403	64.7	220	35.3	
歯数	20歯以上	4,634	77.8	1,324	22.2	<0.001
	19歯以下	87	31.5	189	68.5	
歯間部清掃具使用頻度	毎日	1,034	74.8	349	25.2	0.315
	週1回以上	797	76.7	242	23.3	
	月に1～3回程度	884	76.4	273	23.6	
	使用していない	2,187	74.3	756	25.7	
ゆっくりよくかんで食事する	はい	2,120	81.2	492	18.8	<0.001
	いいえ	2,785	71.3	1,123	28.7	
固いものが食べにくくなった	はい	212	33.1	429	66.9	<0.001
	いいえ	4,696	79.7	1,193	20.3	
お茶や汁物等でむせることがある	はい	646	67.8	307	32.2	<0.001
	いいえ	4,263	76.5	1,312	23.5	
口の渇きが気になる	はい	972	67.3	473	32.7	<0.001
	いいえ	3,935	77.4	1,147	22.6	
この1年間の歯科検診	あり	2,969	76.0	940	24.0	0.071
	なし	1,942	74.0	683	26.0	

表３．左右両方の奥歯でしっかりかみしめられる者の割合についてのロジスティック回帰分析（変数減少法）の結果

		Exp(B)	EXP(B) の 95% 信頼区間		p
			下限	上限	
年齢	20歳代	1.00			
	30歳代	0.96	0.76	1.21	0.736
	40歳代	**1.32**	**1.06**	**1.65**	**0.014**
	50歳代	**1.42**	**1.13**	**1.79**	**0.003**
	60歳代	**1.93**	**1.46**	**2.54**	**0.000**
何人暮らし	1人	1.00			
	2人	**1.36**	**1.05**	**1.76**	**0.021**
	3人	1.18	0.91	1.53	0.217
	4人	1.14	0.88	1.49	0.332
	5人以上	**1.48**	**1.08**	**2.02**	**0.014**
健康保険	国民健康保険	1.00			
	全国健康保険協会管掌健康保険(協会けんぽ)	0.89	0.74	1.07	0.205
	組合管掌健康保険(健康保険組合)	**0.73**	**0.61**	**0.87**	**0.001**
	共済組合	0.80	0.62	1.02	0.076
	その他	0.76	0.42	1.38	0.362
	いずれも加入していない	0.84	0.42	1.68	0.620
教育歴	中学校卒（高校中退を含む）	1.00			
	高校卒（大学中退を含む）	1.03	0.70	1.53	0.874
	専修・専門学校・短大・高専卒	0.87	0.59	1.30	0.506
	大学卒	0.74	0.50	1.09	0.128
	大学院卒	0.67	0.41	1.10	0.112
	その他・不明	1.50	0.62	3.65	0.369
誰かと一緒に食事する機会	毎日ある	1.00			
	週に何度かある	**1.23**	**1.03**	**1.46**	**0.022**
	月に何度かある	1.22	0.98	1.53	0.081
	年に何度かある	0.97	0.70	1.33	0.844
	ほとんどない	**1.64**	**1.11**	**2.41**	**0.013**
野菜料理を食べる頻度	ほぼ毎日	1.00			
	週4～5日	**1.24**	**1.03**	**1.49**	**0.022**
	週2～3日	1.12	0.90	1.39	0.316
	ほとんどない	1.53	0.98	2.40	0.060
主食・主菜・副菜を食べる頻度	ほとんど毎日	1.00			
	週に4～5日	0.99	0.81	1.20	0.906
	週に2～3日	**1.27**	**1.04**	**1.55**	**0.018**
	ほとんどない	1.05	0.80	1.36	0.743
喫煙習慣	喫煙している	1.00			
	喫煙なし	**0.83**	**0.70**	**1.00**	**0.045**
歯数	20歯以上	1.00			
	19歯以下	**3.06**	**2.19**	**4.27**	**0.000**
ゆっくりよくかんで食事する	はい	1.00			
	いいえ	**1.70**	**1.47**	**1.97**	**0.000**
固いものが食べにくくなった	はい	1.00			
	いいえ	**0.18**	**0.14**	**0.22**	**0.000**
口の渇きが気になる	はい	1.00			
	いいえ	**0.85**	**0.72**	**1.00**	**0.043**

目的変数：左右両方の奥歯でしっかりかみしめられる（はい：0、いいえ：1）
説明変数として投入したもの：性、年齢、何人暮らし、等価所得、健康保険、就業状況、生活保護、教育歴、生活習慣病、誰かと一緒に食事する機会、野菜料理を食べる頻度、清涼飲料水を飲む頻度、主食・主菜・副菜を食べる頻度、喫煙習慣、飲酒習慣、友人・知人と会う頻度、歯数、ゆっくりよくかんで食事する、固いものが食べにくくなった、お茶や汁物等でむせることがある、口の渇きが気になる、9区

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

女性の就業状況と健康格差・野菜料理摂取・幸福度

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研究要旨

就労関連では、無職者の健康状態が悪いことを示す先行研究は多くあるが、同じ無職でも自発的に職に就いていないケースも少なくない専業主婦の健康状態に焦点を当てた研究は、十分な研究蓄積がない。

本研究では、健康状態・野菜摂取等について、専業主婦と就業女性、または非就業女性と就業女性の比較を行った。

主な分析結果は以下の通りである。等価所得は、中高年の専業主婦層について、低所得の割合がやや高い。学歴は、中高年の専業主婦層と中高年の就業女性について、差はあまりみられない。中高年の専業主婦層は、野菜摂取の割合はむしろ高い。社会経済的要因(等価所得と教育)を調整した上で、50～64 歳の専業主婦の糖尿病リスクは顕著に高い。幸福度が高い割合は、就業なし女性のほうが就業あり女性よりも高い。

Ａ．研究目的

本分析では、女性の就業状況と健康格差・野菜摂取について分析することを目的とする。第 1 は、女性の就業状況と野菜摂取摂取であり、1 週間の中で摂取する頻度はどのくらい異なるのかを分析する。第 2 は、健康格差として、生活習慣病の 1 つである糖尿病に注目し、女性の就業状況と健康格差を分析する。第 3 は、女性の就業状況と幸福度との関連を分析する。

Ｂ．研究方法

神戸市の 20～64 歳の女性について、3850 サンプルを分析対象とした。女性の就業者は、正規雇用、非正規雇用、自営業・家業、内職、その他の就業形態のいずれかである。女性の就業形態としては、就業者と非就業者、または就業者と専業主婦に分類した。専業主婦は、女性既婚者で、かつ、無職の人々である。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C．研究結果

1　専業主婦・就業女性と等価所得・学歴

図 1～図 2、表 1～表 2 は、専業主婦・就業女性と等価所得・学歴の関係をクロス的に表示している。

図 1　等価所得×女性就業者・専業主婦

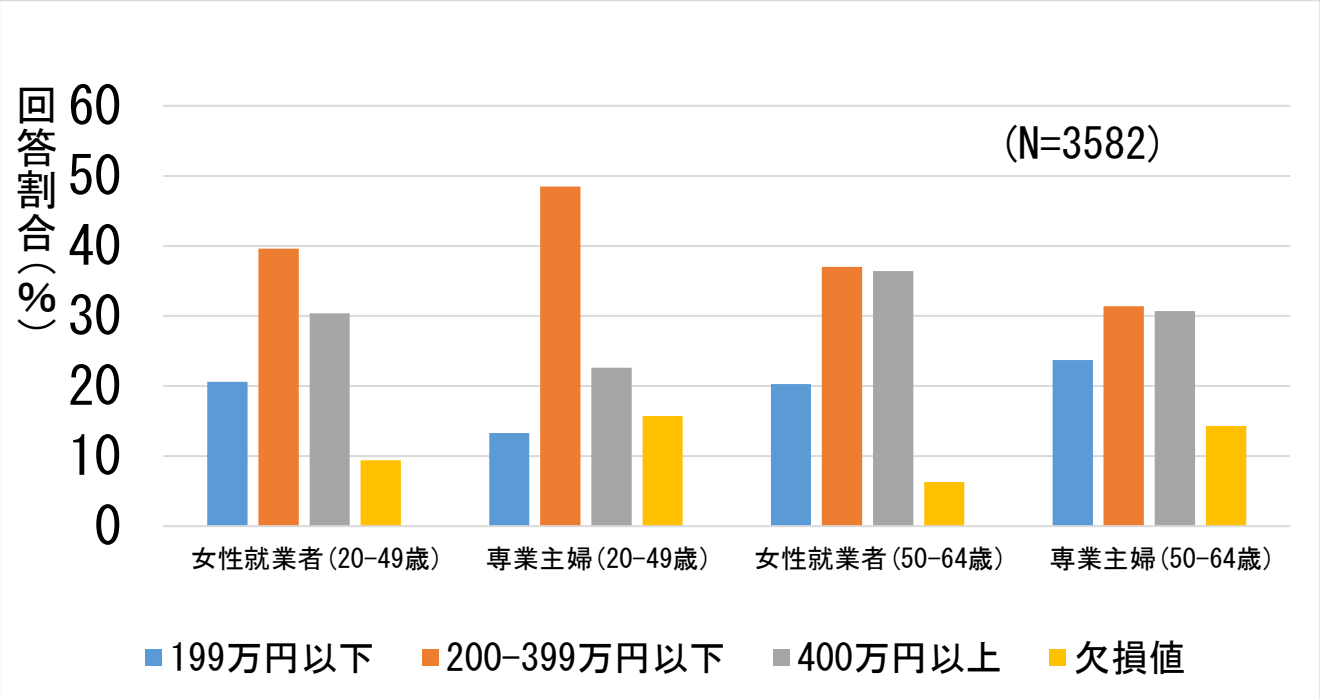


表 1　等価所得×女性就業者・専業主婦(N=3582)

	等価所得			
	199 万円以下	200-399 万円以下	400 万円以上	欠損値
女性就業者(20-49) (N=1999)	20.6%	39.6%	30.4%	9.4%
専業主婦(20-49 歳) (N=460)	13.3%	48.5%	22.6%	15.7%
女性就業者(50-64 歳) (N=836)	20.3%	37.0%	36.4%	6.3%
専業主婦(50-64 歳) (N=287)	23.7%	31.4%	30.7%	14.3%

図 2 学歴×女性就業者・専業主婦

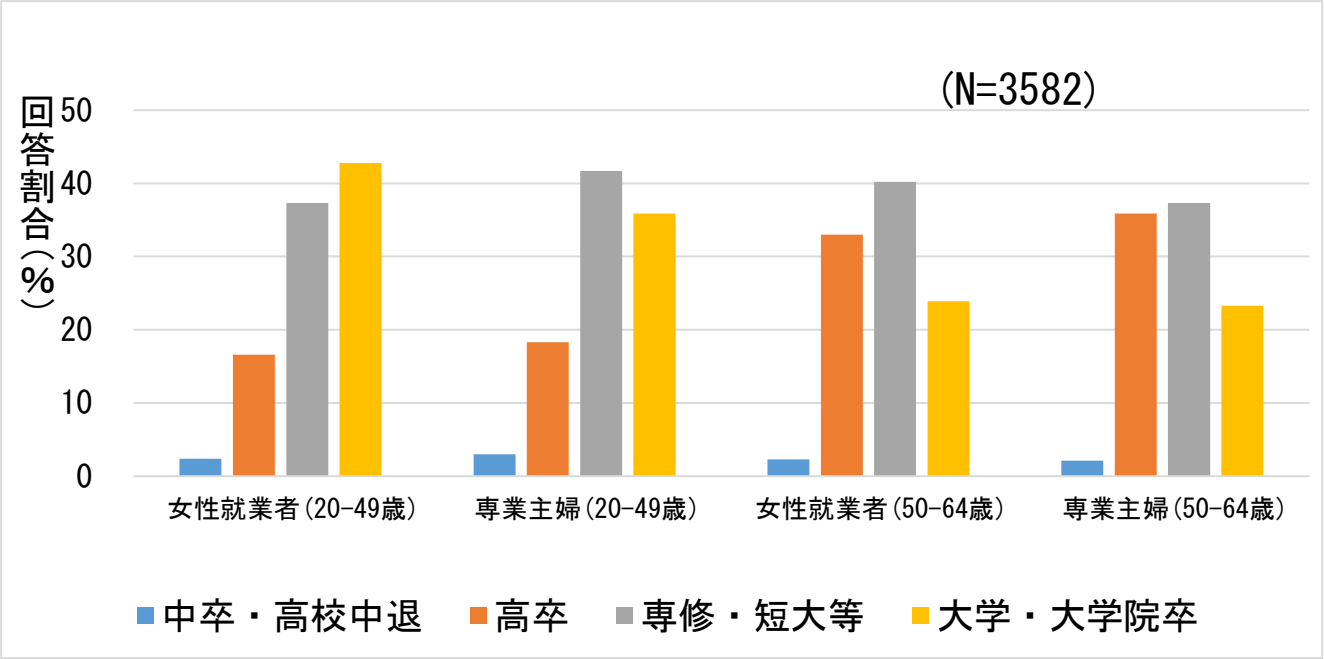


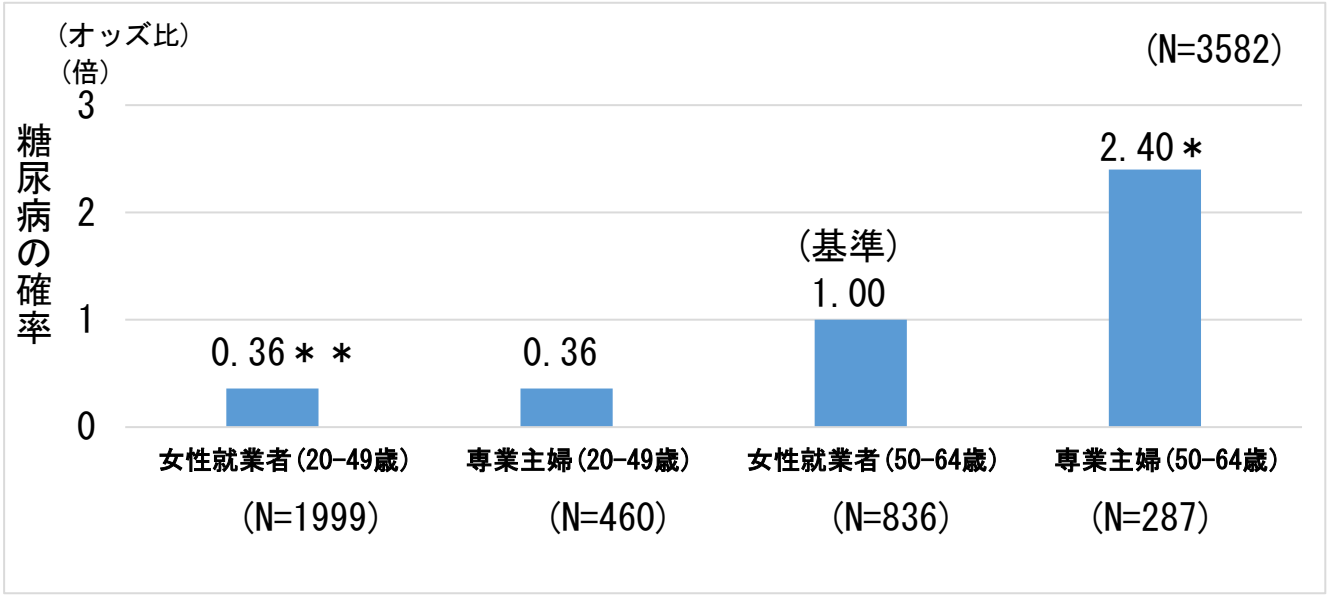
表 2　学歴×女性就業者・専業主婦

	学歴					
	中学卒・高校中退	高校卒	専修・短大卒(中退含む)	大学・大学院卒	その他・わからない	欠損値
女性就業者(20-49 歳)(N=1999)	2.4%	16.6%	37.3%	42.8%	0.7%	0.3%
専業主婦(20-49 歳)(N=460)	3.0%	18.3%	41.7%	35.9%	0.2%	0.9%
女性就業者(50-64 歳)(N=836)	2.3%	33.0%	40.2%	23.9%	0.1%	0.5%
専業主婦(50-64 歳)(N=287)	2.1%	35.9%	37.3%	23.3%	0.0%	1.4%

表 3　野菜料理摂取×女性就業者・専業主婦

	野菜料理摂取				
	ほぼ毎日	週 4～5 回	週 2～3 回	ほとんどない	欠損値
女性就業者(20-49 歳)(N=1999)	58.0%	23.8%	15.3%	2.4%	0.6%
専業主婦(20-49 歳)(N=460)	70.2%	18.5%	10.2%	0.7%	0.4%
女性就業者(50-64 歳)(N=836)	69.5%	16.3%	12.8%	1.0%	0.5%
専業主婦(50-64 歳)(N=287)	80.8%	10.8%	6.3%	0.7%	1.4%

図 4　専業主婦・就業女性と糖尿病



※社会経済的要因(等価所得、教育)の影響を考慮した分析を実施。

＊＊は 1%水準で、＊は 5%水準で、それぞれ統計的に有意な関連があったことを示します。

表 4　幸福度×就労状況(N=3850、女性のみ)

	幸福度高い (7～10 点)
就業あり(20～34 歳)	62.1%
就業なし(20～34 歳)	72.8%
就業あり(35～49 歳)	70.2%
就業なし(35～49 歳)	71.1%
就業あり(50～64 歳)	63.8%
就業なし(50～64 歳)	67.2%

等価所得が 400 万円以上の割合は、20～49 歳の女性就業者は 30.4%、20～49 歳の専業主婦は 22.6%、50～64 歳の女性就業者は 36.4%、50～64 歳の専業主婦は 30.7%である。

また、学歴については、高校卒の割合は、20～49 歳の女性就業者は 16.6%、20～49 歳の専業主婦は 18.3%、50～64 歳の女性就業者は 33.0%、50～64 歳の専業主婦は 35.9%である。

専修・短大卒(中退含む)の割合は、20～49 歳の女性就業者は 37.3%、20～49 歳の専業主婦は 41.7%、50～64 歳の女性就業者は 40.2%、50～64 歳の専業主婦は 37.3%である。

大学・大学院卒の割合は、20～49 歳の女性就業者は 42.8%、20～49 歳の専業主婦は 35.9%、50～64 歳の女性就業者は 23.9%、50～64 歳の専業主婦は 23.3%である。

2　専業主婦・就業女性と野菜料理摂取

表 3 は、専業主婦・就業女性と野菜料理摂取の関係をクロス的に表示している。ほぼ毎日の割合は、20～49 歳の女性就業者は 58.0%、20～49 歳の専業主婦は 70.2%、50～64 歳の女性就業者は 69.5%、50～64 歳の専業主婦は 80.8%である。ほとんどない割合は、20～49 歳の女性就業者は 2.4%、20～49 歳の専業主婦は 0.7%、50～64 歳の女性就業者は 1.0%、50～64 歳の専業主婦は 0.7%である。

3　専業主婦・就業女性と健康格差

図 4 は、女性の就業状況について専業主婦と就業女性、年齢は 20～49 歳と 50～64 歳により、4 つのグループに分類して、糖尿病について女性の健康格差がどのような状況にあるのかを示している。50～64 歳の女性就業者を基準とすると、糖尿病の確率のオッズ比は、20～49 歳の女性就業者は 0.36 倍、20～49 歳の専業主婦は 0.36 倍、50～64 歳の専業主婦は 2.40 倍である。

4　専業主婦・就業女性と幸福度

表 4 は、年齢の違いと女性の就業の有無により 6 区分し、幸福度を表示している。10 点満点の幸福度について、7～10 点を幸福度が高いとして分類している。

幸福度が高い割合は、20～34 歳の就業ありの女性は 62.1%、20～34 歳の就業なしの女性は 72.8%、35～49 歳の就業ありの女性は 70.2%、35～49 歳の就業なしの女性は 71.1%、50～64 歳の就業ありの女性は 63.8%、50～64 歳の就業なしの女性は 67.2%である。

D．考察

神戸市データの分析結果からは、50～64 歳の女性について、糖尿病の確率は、就業女性よりも専業主婦のほうが高いことが示された。また、同じ年齢区分の場合、専業主婦のほうが就業女性の場合よりも野菜料理摂取の頻度は高いことが示された。幸福度は、就業なしの場合のほうが幸福度が高い割合は高かった。

就業と健康の先行研究を踏まえると、就業が健康に及ぼす影響には、就業が健康を高めるという先行研究結果、就業は健康には影響せず中立的であるという先行研究結果、就業はむしろ健康を悪化させるという先行研究結果が示されている。就業による健康影響に先行研究で相反する結果がみられるのは、就業は身体的運動や社会的コミュニケーションが高まることで健康にプラスの影響をもつ側面と、就業は対人関係によるストレスを高めることで健康にマイナスの影響をもつ側面があること、いずれの側面が強く作用するかは個々人がおかれた職場状況により異なるためである。

健康状態(糖尿病)が悪い場合、野菜料理摂取が少なく、幸福度が低いことが考えられる。野菜料理摂取が少ないほど糖尿病などの生活習慣病になりやすいと考えられるからである。また、先行研究から、幸福度が高いほど、ストレス対処や血圧調節や免疫機能の点で有利に作用し、健康アウトカムが良好であることを示す研究結果が蓄積されてきているからである。しかし、神戸市データでは、50～64 歳の年齢層について、専業主婦は就業女性よりも、 野菜料理摂取は多く、幸福度は高いにもかかわらず、健康状態(糖尿病)は悪いことが示されている。

E．結論

野菜料理摂取と幸福度以外の要因、特に、就業女性の就業内容を調査・分析することで、神戸市の女性の就業が健康にどのような影響を及ぼしているのかを分析することが重要と考えられる。

神戸市においては、就業は健康に対して正負のいずれの影響をもつと考えられるか。女性就業の全国平均との比較として、勤務時間の長さ、正規雇用と非正規雇用の割合、職場ストレスの程度や外食、スーパー等での総菜購入の頻度、金額を神戸市調査の新たな追加調査項目案として設定することなどにより、女性の就業と健康の関係を明らかにすることが重要と考えられる。

介入案を検討する際には、行動経済学を政策で応用する際に注目度が高まってきているナッジ理論の応用を検討したい。ナッジとは、個人の選択を十分に維持した上で、商品のメニューや並べ方や動機づけ・サポートを工夫することで、個人の選択のあり方をよりよい方向へ導こうとすることである。ナッジを工夫して健康政策に取り入れることで、健康管理、個人の野菜料理摂取、総菜購買行動に対してプラスの方向へもっていくことが可能になることが考えられる。

F．研究発表

1. 論文発表

なし

2. 学会発表

なし

（発表誌名巻号・頁・発行年等も記入）

G．知的財産権の出願・登録状況

（予定を含む。）

1. 特許取得

なし

2. 実用新案登録

なし

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

がん検診受診状況と受診率向上に向けた取り組みの提案

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研究要旨

本研究では，胃がん検診，肺がん検診，大腸がん検診，子宮がん検診，乳がん検診それぞれの検診の受診状況を健康保険の種別やサードプレイスの有無とともに明らかにし，多くの市民が積極的にがん検診を受診できるような機会を作るための示唆を得ることを目的とした。

その結果，国民健康保険加入者の受診率が低く，さらに，女性では，サードプレイスの存在が検診受診行動と有意に関連していることが明らかとなった。

今後の介入案としては，国民健康保険加入者が集いやすい場での情報提供を行うことなどが挙げられる。また，女性が気楽に集まれるサードプレイスの運営支援，参加の奨励と検診情報提供・各種検診の実施を行っていくことも有効ではないかと考える。

Ａ．研究目的

胃がん検診，肺がん検診，大腸がん検診，子宮がん検診，乳がん検診それぞれの検診の受診状況を健康保険の種別や就業状況などとともに明らかにするとともに，多くの市民が積極的にがん検診を受診できるような機会を作るための示唆を得る。

Ｂ．研究方法

20 歳から 64 歳の神戸市民を対象にした調査データ（N=6,666）から，がん検診の受診状況が不明な 769 名を除外し，5,897 名を対象として分析を行った。

まず，対象者の属性について記述統計を行った。次に性別に，各がん検診の受診状況について，加入している健康保険の種類別に集計し，χ二乗検定を行った。その後各がん検診の受診の有無を目的変数としたロジスティック回帰分析を行い，要因の検討を行った。また，サードプレイスの有無と各がん検診の受診状況について性別ごとに明らかにした。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C．研究結果

1. 対象者の属性　（表 1）

対象者の属性を表 1 に示す。

対象者の属性（n＝5897）

		人	%
年齢	20歳代	1,075	(18.2)
	30歳代	1,310	(22.2)
	40歳代	1,579	(26.8)
	50歳代	1,326	(22.5)
	60歳代	607	(10.3)
性別	男性	2,525	(42.8)
	女性	3,372	(57.2)
健康保険	国民健康保険	1,689	(28.6)
	全国健康保険協会管掌健康保険（協会けんぽ）	1,604	(27.2)
	組合管掌健康保険（健康保険組合）	1,782	(30.2)
	共済組合	671	(11.4)
	その他	82	(1.4)
	いずれも加入していない	69	(1.2)
就業状況	勤め（常勤・正規職員）	3,043	(51.6)
	勤め（パート・アルバイト・非正規職員）	1,382	(23.4)
	自営業・家業	325	(5.5)
	内職	11	(0.2)
	その他の就業形態	66	(1.1)
	仕事をしていない	1,070	(18.1)
世帯収入	５０万円未満	172	(2.9)
	５０～１００万円未満	136	(2.3)
	１００～１５０万円未満	152	(2.6)
	１５０～２００万円未満	188	(3.2)
	２００～２５０万円未満	247	(4.2)
	２５０～３００万円未満	325	(5.5)
	３００～４００万円未満	628	(10.6)
	４００～５００万円未満	667	(11.3)
	５００～６００万円未満	657	(11.1)
	６００～７００万円未満	558	(9.5)
	７００～８００万円未満	557	(9.4)
	８００～９００万円未満	378	(6.4)
	９００～１，０００万円未満	340	(5.8)
	１，０００万円～１，２００万円未満	439	(7.4)
	１，２００万円以上	453	(7.7)
サードプレイスの有無	サードプレイスなし	3,672	(62.7)
	サードプレイスがある	2,180	(37.3)
がん検診受診	胃がん検診	1,981	(33.6)
	肺がん検診	2,587	(43.9)
	大腸がん検診	2,245	(38.1)
	子宮がん検診	1,775	(52.6)
	乳がん検診	1,493	(44.3)

2. 加入保険別，およびサードプレイスの有無別検診受診状況　（表 2，表 3，表 4）

胃がん，肺がん，大腸がん，子宮頸がん，乳がんの検診受診状況を，性別で分け，加入保険種別に集計したものを表 2 に示す。いずれの検診においても**「国民健康保険」加入者の受診率が「全国健康保険協会管掌健康保険（協会けんぽ）」「組合管掌健康保険（健康保険組合）」「共済組合」の加入者と比較して有意に低かった。**

健康保険の種類別受診者数

		胃がん検診			肺がん検診			大腸がん検診			子宮がん検診			乳がん検診		
		n	%	p	n	%	p	n	%	p	n	%	p	n	%	p
男性	国民健康保険	199	27.7%		258	35.9%		234	32.5%							
	全国健康保険協会管掌健康保険（協会けんぽ）	289	46.1%		343	54.7%		297	47.4%							
	組合管掌健康保険（健康保険組合）	438	52.9%	.000	504	60.9%	.000	450	54.3%	.000						
	共済組合	133	47.2%		161	57.1%		124	44.0%							
	その他	13	37.1%		15	42.9%		12	34.3%							
	いずれも加入していない	7	20.6%		8	23.5%		5	14.7%							
女性	国民健康保険	190	19.6%		287	29.6%		242	24.9%							
	全国健康保険協会管掌健康保険（協会けんぽ）	265	27.1%		406	41.6%		340	34.8%							
	組合管掌健康保険（健康保険組合）	304	31.9%	.000	424	44.4%	.000	396	41.5%	.000						
	共済組合	129	33.2%		163	41.9%		129	33.2%							
	その他	13	27.7%		18	38.3%		14	29.8%							
	いずれも加入していない	1	2.9%		0	0.0%		2	5.7%							
合計	国民健康保険	389	23.0%		545	32.3%		476	28.2%		445	45.9%		339	34.9%	
	全国健康保険協会管掌健康保険（協会けんぽ）	554	34.5%		749	46.7%		637	39.7%		513	52.5%		429	43.9%	
	組合管掌健康保険（健康保険組合）	742	41.6%	.000	928	52.1%	.000	846	47.5%	.000	550	57.7%	.000	501	52.5%	.000
	共済組合	262	39.0%		324	48.3%		253	37.7%		237	60.9%		198	50.9%	
	その他	26	31.7%		33	40.2%		26	31.7%		20	42.6%		18	38.3%	
	いずれも加入していない	8	11.6%		8	11.6%		7	10.1%		10	28.6%		8	22.9%	

次に，各がん検診の受診の有無を目的変数，保険種別を説明変数として，年齢と年収を調整したロジスティック回帰分析を行った。胃がん検診，肺がん検診，大腸がん検診では性別も共変量とした。

健康保険の種類と受診者

		国民健康保険	全国健康保険協会管掌健康保険（協会けんぽ）	組合管掌健康保険（健康保険組合）	共済組合	その他	いずれも加入していない
		(n=1689)	(n=1604)	(n=1782)	(n=671)	(n=82)	(n=69)
胃がん検診							
	Crude OR (95%C.I.)	1.00 (reference)	1.76 (1.51-2.05)	2.38 (2.06-2.76)	2.14 (1.77-2.59)	1.55 (0.96-2.50)	0.44 (0.21-0.92)
	Adjusted OR (95%C.I.)a	1.00 (reference)	**1.44 (1.21-1.71)**	**1.72 (1.45-2.04)**	**1.78 (1.42-2.23)**	1.46 (0.86-2.48)	0.50 (0.22-1.11)
肺がん検診							
	Crude OR (95%C.I.)	1.00 (reference)	1.84 (1.60-2.12)	2.28 (1.99-2.62)	1.96 (1.63-2.35)	1.41 (0.90-2.22)	0.28 (0.13-0.58)
	Adjusted OR (95%C.I.)a	1.00 (reference)	**1.55 (1.33-1.81)**	**1.74 (1.49-2.03)**	**1.68 (1.36-2.06)**	1.35 (0.83-2.21)	**0.32 (0.15-0.71)**
大腸がん検診							
	Crude OR (95%C.I.)	1.00 (reference)	1.68 (1.45-1.94)	2.30 (2.00-2.65)	1.54 (1.28-1.86)	1.18 (0.73-1.91)	0.29 (0.13-0.63)
	Adjusted OR (95%C.I.)a	1.00 (reference)	**1.34 (1.13-1.58)**	**1.70 (1.44-2.01)**	1.22 (0.97-1.52)	1.05 (0.62-1.78)	**0.29 (0.13-0.67)**
子宮がん検診							
	Crude OR (95%C.I.)	1.00 (reference)	1.30 (1.09-1.56)	1.61 (1.34-1.92)	1.84 (1.45-2.34)	0.87 (0.48-1.58)	0.47 (0.22-0.99)
	Adjusted OR (95%C.I.)b	1.00 (reference)	1.13 (0.94-1.36)	**1.24 (1.02-1.50)**	**1.39 (1.08-1.80)**	0.86 (0.46-1.59)	0.65 (0.30-1.42)
乳がん検診							
	Crude OR (95%C.I.)	1.00 (reference)	1.46 (1.21-1.75)	2.06 (1.71-2.47)	1.93 (1.52-2.45)	1.16 (0.63-2.11)	0.55 (0.25-1.23)
	Adjusted OR (95%C.I.)b	1.00 (reference)	1.19 (0.98-1.46)	**1.51 (1.23-1.85)**	**1.64 (1.24-2.15)**	1.11 (0.57-2.16)	0.79 (0.33-1.87)

OR=odds ratio; CI=confidence interval.
a Adjusted for sex, age, income
b Adjusted for age, income

その結果，「国民健康保険」加入者を基準とすると，胃がん検診，肺がん検診では，「全国健康保険協会管掌健康保険（協会けんぽ）」「組合管掌健康保険(健康保険組合)」「共済組合」加入者は有意にオッズ比（OR）が高かった。大腸がん検診では「全国健康保険協会管掌健康保険（協会けんぽ）」「組合管掌健康保険(健康保険組合)」加入者の OR が有意に高かった。乳がん検診，子

宮がん検診では，「組合管掌健康保険(健康保険組合)」，「共済組合」加入者は有意に OR が高かった。

サードプレイスの有無と各がん検診の受診状況について性別ごとに集計したものを表 4 に示す。女性においては全ての検診において，サードプレイスを持たない人に比べ，持つ人の受診率が高い傾向が見られた。一方，男性では差が見られなかった。

サブ解析として，女性に限定し，年齢と年収を調整してロジスティック回帰分析を行った。全てのがん検診において，サードプレイスを有する人は受診の見込みが高いという結果が得られた。

サードプレイスの有無と受診者数

		胃がん検診			肺がん検診			大腸がん検診			子宮がん検診			乳がん検診		
		n	%	p	n	%	p	n	%	p	n	%	p	n	%	p
男性	サードプレイス無	690	42.5%	.933	825	50.8%	.900	716	44.1%	.866						
	サードプレイス有	374	42.6%		448	51.1%		390	44.5%							
女性	サードプレイス無	490	23.9%	.000	736	36.0%	.001	618	30.2%	.000						
	サードプレイス有	394	30.2%		545	41.8%		488	37.5%							
合計	サードプレイス無	1180	32.1%	.016	1561	42.5%	.024	1334	36.3%	.003	1026	50.1%	.001	339	34.9%	.000
	サードプレイス有	768	35.2%		993	45.6%		878	40.3%		729	55.9%		429	43.9%	

3. 国民健康保険×サードプレイス

これまでの分析により，いずれのがん検診においても，「国民健康保険」加入者の受診率が低く，女性ではサードプレイスを持つ人の受診率が高いことが明らかになった。追加分析として，「国民健康保険」加入者でサードプレイスを持つ対象者が具体的にどのような場所に集うのかを集計したところ，習い事・趣味 37.1%，カフェ 30.9%，飲み屋 13.6%，スポーツクラブ・ジム 20.9%，公園 8.3%という結果であった。

D．考察

男女ともに，いずれのがん検診においても「国民健康保険」加入者の受診率が低かった。20-64 歳の国民健康保険」加入者とは即ち「職場の健康保険」に加入していないすべての人であり，主に自営業の人，退職者，パートやアルバイトなどの雇用が不安定な人を含む。今後がん検診の未受診者に対する効果的な受診勧奨対策を実施するには，勤務している会社での定期検診を当たり前に受けられる状況にない人々に対する積極的なアプローチが必要であると考えられる。大阪市ではハローワークでの結核健診が実施されているが，そのような場を利用しての情報提供ならびに検診の実施は有効である可能性もある。

女性では，年齢，年収を補正してもサードプレイスの存在が受診行動と有意な関連を示したことは，興味深い結果である。女性では，サードプレイスを持つことが検診受診の鍵になる可能性が示唆される。また，集いやすいサードプレイスとして，「習い事・趣味の場」「カフェ」「スポーツクラブ・ジム」などが挙げられ，こうした場の設置・運営の支援，参加の奨励を行った上で，検診受診の啓発活動を行っていくことも有効ではないかと考えられる。

以上より，以下のような介入策が提案される。

- 「国民健康保険」加入者が集いやすい場（スーパーなど）での情報提供
- ハローワークでの情報提供ならびに各種検診の実施
- 女性を対象としたサードプレイス（習い事・趣味の場，カフェ，スポーツジム）での情報提

供ならびに各種検診の実施

Ｅ．結論

今後，がん検診の未受診者に対する効果的な受診勧奨対策を実施するには，国民健康保険加入者，つまり勤務している会社での定期検診を当たり前に受けられる状況にない人々に対する積極的なアプローチが必要であると考えられる。さらに女性ではサードプレイスを持たないことが，未受診リスクにつながっている。故に，雇用が不安定な低所得者へのアプローチや，未受診の人々が集まりやすい場（サードプレイス）での情報提供ならびに各種検診検診の機会を提供していくことが受診率向上につながるのではないかと考える。

Ｆ．研究発表

1. 論文発表

なし

2. 学会発表

なし

Ｇ．知的財産権の出願・登録状況

（予定を含む。）

1. 特許取得

なし

2. 実用新案登録

なし

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

就労子育て世代へのアプローチ（サードプレース関連要因の追加分析）

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研究要旨

サードプレースは、自宅以外に居心地よく感じる場所であり、自宅と職場や学校の間を結び、非公式な出会いや、健康情報などのやり取りが生まれる場所となっている。これまで、神戸市では、子育てサークルや児童館において健康教育を実施してきたが、20 歳から 64 歳を対象に行った調査を分析した結果、これら健康教育事業への参加は全体の 1 割に満たなかった。神戸市としては、子育て世代へのアプローチのために、就労子育て世代への関わり方を検討する必要がある。

そこで、本研究では、20 歳から 40 歳の就労者で子どもと同居している回答者 835 名に絞った分析を行った。特にサードプレース「その他」の自由記載の分析では、全データ（N=6657）では、祖父母を含む親族宅をあげた人は 98 人（21.2%）に対し（昨年度の報告書参照)、40 歳以下の就労子育て世代の自由記載 47 件の分析では、51%と、祖父母を含む親族の割合が高かった。

一方、就労子育て世代の 6.8%（N=57）は一人親（死別・離別・未婚など）であり、サードプレースがあると回答した割合は若干多かった（配偶者ありの 25.4%に対し 26.3%）ものの、一人親ほど、抑うつ（K6 で 5 点以上）が多く（配偶者ありの 30.3%に対し 51.8%)、喫煙者割合も 19%に対し 26.8%と多かった。つまり、健康指標が良好でないことがわかった。また、低所得者（年間 200 万未満）の割合も高く（配偶者ありの 14.4%に対し 76.4%)、健康格差の是正には、一人親にターゲットを絞った介入の有用性が示唆された。

なお、本研究では、健康リスクの高い世帯での回収率が低い可能性もあるため、今後の事業にあたり、聞き取りなど質的情報の収集が有用と思われる。

A．研究目的

就労子育て世代への子育て支援のための保健情報を効果的に行うために、20 から 40 歳の就労者で子どもと同居している人（N=835）に絞った分析を行い、就労子育て世代のサードプレースの関連要因を検討することを目的とした。

B．研究方法

20 歳から 64 歳の神戸市民を対象にした調査データから、40 歳以下で子どもと同居しており、就労していると回答した 835 名について分析を行った。サードプレースの有無と就労形態、婚姻状態との関連、およびサードプレースで「その他」と回答している者の自由記載 47 件を質的に検討した。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C．研究結果

全体のデータ（N=6657）では、サードプレース「あり」が男性 35%、女性 38.7%であったのに対し、40 歳以下では、男性 22.4%、女性 27.9%と少ない傾向であった。就労状態との関連では、常勤の 25.1%に比べ、それ以外では 26.1%と大きな違いはなかった。婚姻状態では、配偶者がいない人（つまり一人親）ほど、サードプレースがあると回答していた（配偶者ありの 25.4%に対し 26.3%）。

全体データでは、「その他」の自由記載（463 件）で、キッズスペースや児童館、親子教室などをあげた人は 27 人（5.8%）、一方、祖父母宅を含む親族宅をあげた人は 98（21.2%）であった（昨年度の報告書参照）。今回、40 歳以下で子どもと同居する就労者（N=835）に限ったところ、自由記載 47 件（すべて一人親）の内、それぞれ、児童館や親子教室などで 2.1%、祖父母宅を含む親族宅が 51%（祖父母宅だけで 46.8%）と、児童館などの公的スペースをあげる割合が少ない一方、祖父母宅を含む親族の割合が高かった。子育てサークルへの参加については、40 歳以下の就労子育て世代においても「参加していない」との回答が 88.5%を占めた。

一方、就労子育て世代の 6.8%（N=57）は一人親（死別・離別・未婚など）であり、サードプレースがあると回答した割合は若干多かった（配偶者ありの 25.4%に対し 26.3%）ものの、健康指標に関しては、一人親ほど、抑うつ（K6 で 5 点以上）が多く（配偶者ありの 30.3%に対し 51.8%）、喫煙者割合も 19%に対し 26.8%と多かった。低所得者（年間 200 万未満）の割合も多く（配偶者ありの 14.4%に対し 76.4%）、健康格差の是正には、一人親にターゲットを絞った介入の有用性が示唆された。

D．考察

N は少ないものの、公的スペースよりも、祖父母などの親族が、特に一人親世帯のサポートを行っていることが推測された。就労子育て世代には、時間的制約などから、児童館などの公的サービスが使いにくい可能性もある。特に若い世代には、SNS などを用いた情報提供が有用かもしれない。また、就労子育て世代は、子育て支援を祖父母に頼っている可能性があるため、祖父母をターゲットにしたアプローチも有用かもしれない。

また、一人親では、喫煙者が多く、抑うつも多く、所得も低い状況であった。抑うつや低所得は、虐待リスクとも関連しているため、一人親世帯に対するアプローチは重要と思われる。

E．結論

一人親（死別・離別・未婚など）の場合、貧困など様々な困難を抱えている可能性もあり、健康格差の是正には、ターゲットを絞った介入も必要と思われる。サードプレースを格差縮小の場

とするためには、聞き取りなど質的検討による情報収集も有用と思われる。

F．研究発表

1. 論文発表

なし

2. 学会発表

なし

G．知的財産権の出願・登録状況

（予定を含む。）

1. 特許取得

なし

2. 実用新案登録

なし

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

社会参加と健康指標の関連および所得階層別の社会参加割合

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千葉大学大学院　博士課程
研究代表者　近藤　克則　国立長寿医療研究センター老年学評価研究部　部長

研究要旨

地域在住高齢者を対象とした研究で社会参加が健康へ好影響をもたらすこと，通いの場サロンのような社会参加の場で低所得者層の参加が多いことが確認されている．しかし，青壮年期における社会参加と健康指標の関連，社会参加の種類と所得階層毎の参加割合に関する報告は少ない．そこで本研究の目的は 2 点ある．第 1 に健康指標へ好影響をもたらす社会参加の種類を明らかにすること，第 2 に所得階層毎に社会参加の種類によって参加割合が異なるかを明らかにすることである．

神戸市在住 20-64 歳の 20,000 名に自記式郵送調査法にてアンケートを行い，回答を 6,666 名から得た．社会参加と健康指標の関連を明らかにするために，9 種類の健康指標を目的変数，10 種類の社会参加を説明変数とし，性・年齢・社会経済的要因を調整したロジスティック回帰分析を行った．次に 10 種類の社会参加の有無を目的変数，等価所得（200 万未満，200－399 万，400 万以上）を説明変数とし，性・年齢を調整したロジスティック回帰分析を行った．

結果，スポーツグループへ参加者は非参加者に対し 7 種類の健康指標が有意に良好であることが示唆された．また社会参加の種類によって，等価所得 400 万以上や 200－399 万で参加が多い社会参加が存在することが明らかとなった．青壮年期においてもスポーツグループのような社会参加と健康指標が関連している可能性がある．今後は社会参加者増加の向けた研究が重要である．

A．研究目的

地域在住高齢者を対象とした研究で社会参加が健康へ好影響をもたらすこと[1-3]，通いの場サロンのような社会参加の場で低所得者層の参加が多いこと[4]が確認されている．しかし，青壮年期における社会参加と健康指標の関連，社会参加の種類と所得階層毎の参加割合に関する報告は少ない．そこで本研究の目的は 2 点ある．第 1 に健康指標へ好影響をもたらす社会参加の種類を明らかにすること，第 2 に所得階層ごとに社会参加の種類によって参加割合が異なるかを明らかにすることである．

B. 方法

B－１：対象

神戸市在住 20-64 歳の 20,000 名に自記式郵送調査法にてアンケートを行い，回答を 6,666 名から得た．そのうち，性・年齢不明な者（50 名），研究同意を得ない者（1,016 名）を除外した．分析対象者は分析に必要な目的変数に欠損がある場合は除外し各目的変数に応じ，5,068 名から 5,600 名とした．

B－２：変数

（１）健康指標

健康指標は下記の 9 種類を用いた．①疾患（糖尿病，高血圧，高脂血症，心臓の病気，喘息，アトピー性皮膚炎，胃・十二指腸の病気，肝臓病，うつ病や心の病気，頭痛，不眠症，子宮や卵巣の病気，前立腺や泌尿器の病気，悪性腫瘍，関節炎・リウマチ，首や腰の病気，骨折，脳卒中，認知症，目の病気，耳の病気，その他）あり，②三大疾患（心臓の病気，悪性腫瘍，脳卒中）あり，③生活習慣病（糖尿病，高血圧，高脂血症）あり，④喫煙なし，⑤朝食欠食あり，⑥検診未受診，⑦運動習慣あり，⑧主観的健康感よくない，⑨心の健康不良（K6 の合計点 5 点以上）を用いた．

（２）社会参加の種類

社会参加の種類は以下の 10 種類とした．①健康や医療サービスに関係したボランティア活動，②①以外のボランティア活動，③スポーツクラブ関係のグループやクラブ，④趣味関係，⑤町内会・自治会・婦人会・ふれあいのまちづくり協議会，⑥学習・教養サークル，⑦特技や経験を他者へ伝える活動，⑧子育てサークル，⑨NPO（民間非営利団体），⑩生協（生活協同組合）を用い，それぞれの会への参加頻度を「していない」，「年に数回」，「月 1 ～3 回」，「週 1 回以上」から選択し回答を得た．本研究では「年に数回以上」を参加ありと定義した．

（３）社会経済的要因

社会経済的要因には等価所得と教育歴を使用した．等価所得は 200 万未満，200-399 万，400 万以上，無回答の 4 群とした．教育歴は高校卒業未満，高校卒業，専門・短大卒・大学中退，大学卒業以上，その他,，無回答の 6 群とした．

B－３：分析方法

（１）　健康指標と社会参加の関係を示すために，9 種類の健康指標を目的変数に 10 種類の会やグループ参加を説明変数とし，共変量に性・年齢・社会経済的要因（等価所得・教育歴），他のグループへの参加を同時投入したロジスティック回帰分析を行った．

（２）　社会参加者のうち，種類ごとの社会経済的な参加者の特徴を明らかにするために，目的変数を 10 種類の社会参加，説明変数を等価所得（200 万未満，200-399 万，400 万以上）とし，共変量に性・年齢を同時投入したロジスティック回帰分析を行った．

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C. 結果

C－１：記述統計

表１： 会やグループの参加頻度と割合

	年数回		月 1−3 回		週 1 回以上	
	n	%	n	%	n	%
（1）健康や医療サービスに関係したボランティア活動	94	1.7	30	0.5	10	0.2
（2）（1）以外のボランティア活動	245	4.4	124	2.2	82	1.5
（3）スポーツクラブ関係のグループやクラブ	205	3.7	325	5.8	492	8.8
（4）趣味関係	541	9.7	535	9.6	354	6.3
（5）町内会・自治会・婦人会・ふれあいのまちづくり協議会	443	7.9	128	2.3	20	0.4
（6）学習・教養サークル	127	2.3	99	1.8	77	1.4
（7）特技や経験を他者へ伝える活動	116	2.1	63	1.1	52	0.9
（8）子育てサークル	123	2.2	71	1.3	36	0.6
（9）NPO（民間非営利団体）	70	1.3	27	0.5	24	0.4
（１０）生協（生活協同組合）	54	1.0	32	0.6	132	2.4

表２：等価所得別の社会参加の有無

	年数回以上参加者							
	全体		200 万未満		200－399 万		400 万以上	
	n	%	n	%	n	%	n	%
（1）健康や医療サービスに関係したボランティア活動	134	2.4	32	3.0	49	2.3	47	2.4
（1）以外のボランティア活動	451	8.1	74	6.9	181	8.4	166	8.5
スポーツクラブ関係のグループやクラブ	1022	18.3	153	14.3	348	16.1	462	23.6
趣味関係	1430	25.5	260	24.3	496	23.0	575	29.4
町内会・自治会・婦人会・ふれあいのまちづくり協議会	591	10.6	102	9.5	262	12.1	195	10.0
学習・教養サークル	303	5.4	53	4.9	107	5.0	127	6.5
特技や経験を他者へ伝える活動	231	4.1	43	4.0	85	3.9	88	4.5
子育てサークル	230	4.1	43	4.0	123	5.7	50	2.6
NPO（民間非営利団体）	121	2.2	26	2.4	42	1.9	46	2.4
生協（生活協同組合）	218	3.9	35	3.3	109	5.0	60	3.1

※等価所得無回答者 414 名の結果は評価から除外

表3：各種会やグループ参加と健康指標との関連（ロジスティック回帰分析）

		全疾患有	三大疾患有	生活習慣病有	喫煙しない	朝食食べない	検診受けない	運動習慣ある	主観的健康感よくない	K6：5点以上	保護的指標の数
		n=5,600	n=5,600	n=5,600	n=5,563	n=5,558	n=5,488	n=5,068	n=5,576	n=5,469	
		OR	OR	OR	OR	OR	OR	OR	OR	OR	
（1）健康や医療サービスに関係したボランティア活動	年数回以上参加	1.63	0.79	0.76	1.53	0.81	0.66	1.44	0.84	0.99	0
（1）以外のボランティア活動		1.19	1.11	0.84	1.30	1.16	0.84	1.35	0.78	0.91	1
スポーツクラブ関係のグループやクラブ		0.94	0.92	0.73	1.13	0.75	0.78	3.91	0.56	0.83	7
趣味関係		1.19	1.37	1.10	1.37	0.81	0.87	1.22	0.94	0.95	1
町内会・自治会・婦人会・ふれあいのまちづくり協議会		0.75	1.20	1.20	0.84	0.83	0.94	0.98	0.97	0.94	0
学習・教養サークル		1.12	0.89	0.85	1.79	1.11	0.86	0.94	1.17	1.25	1
特技や経験を他者へ伝える活動		0.99	1.09	1.05	0.98	1.41	1.31	1.32	1.19	0.91	0
子育てサークル		0.78	0.89	0.56	1.86	0.34	1.43	0.70	0.56	0.65	4
NPO（民間非営利団体）		1.09	1.54	1.14	0.78	1.28	1.10	1.38	0.72	0.88	0
生協（生活協同組合）		0.99	1.05	0.78	0.78	1.41	1.14	1.30	0.92	1.38	0

※年齢・性・10種類の会やグループの参加，等価所得・教育歴を同時投入したロジスティック回帰分析を行った（参照群は参加なしとした）．

保護的(p<0.05)
保護的(p<0.10)
非保護的(p<0.05)

スポーツグループ参加者は社会経済的な要因を調整しても健康指標と最も良好な関連を示した．具体的には 9 つの健康指標のうち，7 つの指標で統計学的に保護的な関連を示した．

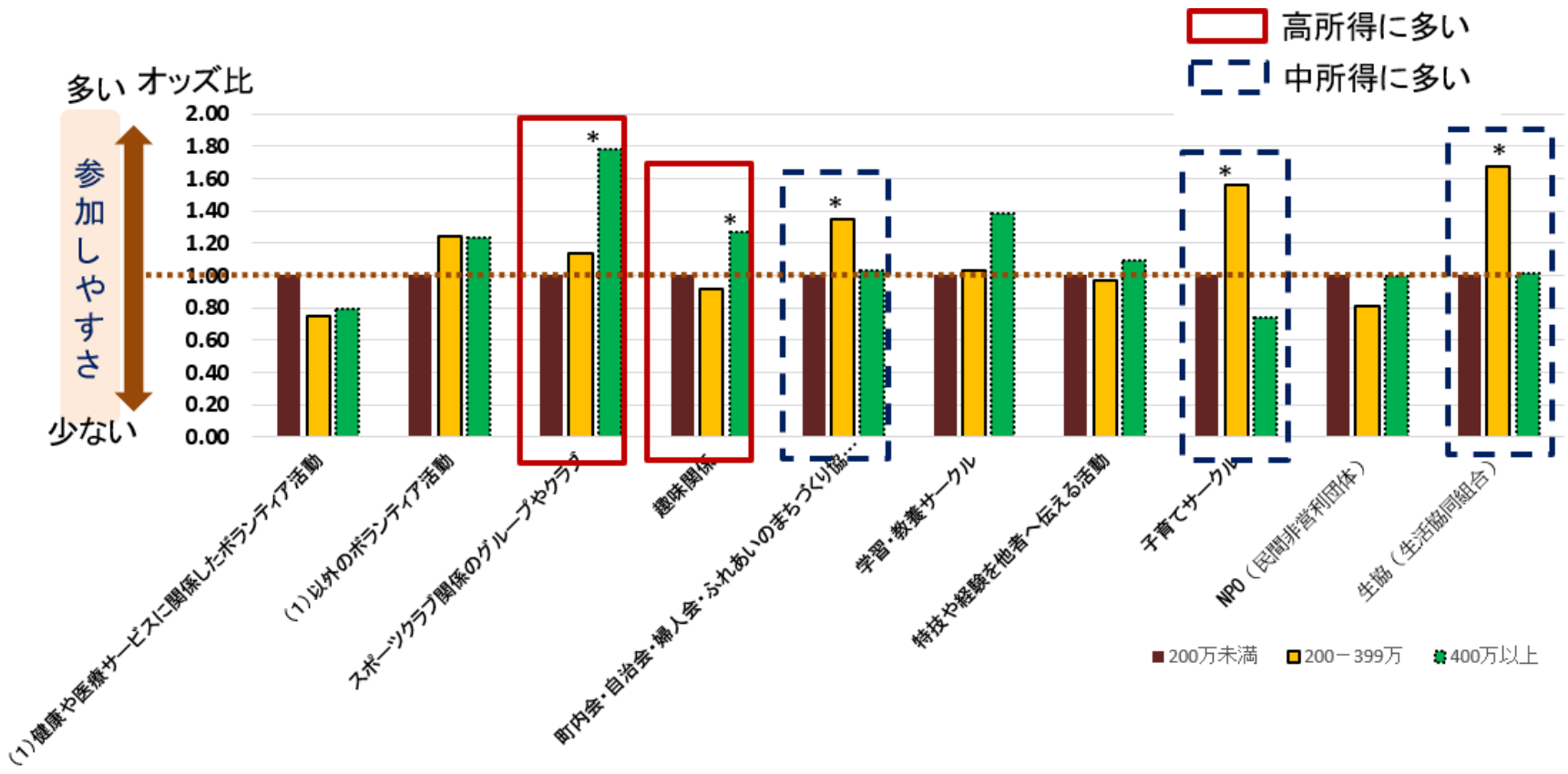


図 1.社会参加の種類と所得階層

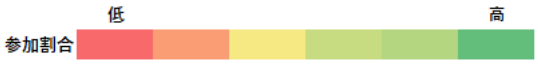
※それぞれの参加有りは年数回以上で参加ありとした。

等価所得 400 万以上の高所得者層に参加が多い社会参加はスポーツの会，趣味関係であった．等価所得 200－399 万の中所得者層の参加が多い社会参加は町内会・自治会・婦人会，子育てサークル，生協であった．

表４：健康指標へ良好であるスポーツの会の参加状況（行政区別・所得階層別）

	全体			200 万未満			200－399 万			400 万以上		
	年数回以上（人）	全体（人）	参加割合（%）	年数回以上（人）	全体（人）	参加割合（%）	年数回以上（人）	全体（人）	参加割合（%）	年数回以上（人）	全体（人）	参加割合（%）
地区不明	4	21	19.0	0	0	0	2	7	28.6	1	6	16.7
須磨区	102	527	19.4	18	111	16.2	39	216	18.1	39	155	25.2
垂水区	152	839	18.1	22	161	13.7	54	318	17.0	67	304	22.0
西区	193	942	20.5	30	163	18.4	62	401	15.5	90	309	29.1
中央区	80	491	16.3	9	92	9.8	28	162	17.3	40	200	20.0
長田区	42	276	15.2	11	95	11.6	19	93	20.4	8	69	11.6
東灘区	156	847	18.4	17	135	12.6	42	282	14.9	90	375	24.0
灘区	99	519	19.1	12	84	14.3	36	199	18.1	44	187	23.5
兵庫区	68	372	18.3	16	90	17.8	25	161	15.5	22	93	23.7
北区	126	766	16.4	17	138	12.3	41	321	12.8	61	257	23.7
合計	1022	5600	18.3	153	1071	14.3	348	2160	16.1	462	1955	23.6

※等価所得無回答者 414 名の結果は評価から割愛



健康指標に対して最も良好な結果を示したスポーツの会の行政区別・所得階層別参加割合を示した．結果，全体では高所得者層に多いが，低所得者層においても西区，兵庫区，須磨区で参加割合が高かった．

D. 考察

本研究の主な所見は，青壮年を対象とした社会参加ではスポーツの会へ参加している者の健康指標が良好であること，社会参加の種類で参加が多い所得階層が異なることを示したことである．

これまでの研究で高齢者を対象にスポーツの会へ参加していることが要介護リスクを軽減させることが報告されている[2,3,5-7]．本研究結果もこれを支持した．また，高齢者を対象とした研究でスポーツの会へ参加しているものには社会経済的要因が良好な者がおおいことが報告されているが[8]，本研究はこれを支持した．一方，行政区別にみていくと，西区，兵庫区，須磨区で低所得者での参加割合が他の地区と比較して高い傾向があった．これらの地域では，低所得者層がスポーツの会へ参加しやすい環境が整っているかもしれない．

E. 結論

神戸市在住 20-64 歳の青壮年者を対象に社会参加と健康指標の関係，社会参加の種類と等価所得別の参加割合を調査した．結果，10 種類の社会参加で最も健康指標が良好であったのはスポーツの会へ参加しているものであった．また 10 種類の社会参加の種類によって，所得階層で参加割合が異なることが明らかとなった．スポーツの会は高所得者に多い傾向がみられたが，低所得者

層で参加者が多い地区があることも明らかとなった.

Ｆ．研究発表

1. 論文発表

なし

2. 学会発表

なし

Ｇ．知的財産権の出願・登録状況

（予定を含む.）

1. 特許取得

なし

2. 実用新案登録

なし

H. 参考文献

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SCIENTIFIC REPORTS
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Infrequent Denture Cleaning Increased the Risk of Pneumonia among Community-dwelling Older Adults: A Population-based Cross-sectional Study

Received: 10 July 2019
Accepted: 6 September 2019
Published online: 24 September 2019

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Pneumonia is a leading cause of death among older adults. The effectiveness of oral care in preventing pneumonia in nursing homes and hospitals has been reported. However, in community-dwelling older adults, the role of denture cleaning in preventing pneumonia remains unknown. We aimed to investigate the association between infrequent denture cleaning and the risk of pneumonia in community-dwelling older adults. This cross-sectional study was based on the self-reported questionnaire targeting towards community-dwelling older adults aged ≥65 years. Responses of 71,227 removable full/partial denture users were included. The incidence of pneumonia within the last one-year and the frequency of denture cleaning (daily/non-daily) were treated as dependent and independent variables, respectively. The odds ratio (OR) and 95% confidence interval (CI) were calculated by the inverse probability weighting (IPW) method based on the logistic regression model. The mean age of the participants was 75.2 ± 6.5 years; 48.3% were male. Overall, 4.6% of the participants did not clean their dentures daily; 2.3% and 3.0% who did and did not clean their dentures daily, respectively, experienced pneumonia. After IPW, infrequent denture cleaning was significantly associated with pneumonia incidence (OR = 1.30, 95% CI = 1.01–1.68)). This study suggests that denture cleaning could prevent pneumonia among community-dwelling older adults.

Pneumonia is a leading cause of hospitalization and death[1,2]. It is widely prevalent among the older population because of the decline in immune system and respiratory function with advancing age[3]. Aspiration is one of the mechanisms that explains the onset of pneumonia among older adults[4,5]. In fact, oral bacteria have been identified in the lungs of the patients who developed pneumonia; therefore, a relationship between aspiration of oral bacteria and pneumonia is strongly suggested[6]. In addition, because a substantial proportion of older adults are affected by dysphagia[7,8], the risk of pneumonia through aspiration may increase[4]. To reduce the risk of aspiration pneumonia, oral care has been implemented in nursing homes and has successfully decreased the incidence of pneumonia among the nursing home residents[9–11].

Although the role of oral care in reducing the risk of pneumonia has been recognized, the importance of denture cleaning has been relatively neglected. The presence of fewer or no teeth is prevalent among the older adults[12]; therefore, the use of removable dentures is a common treatment option. On the surface of the denture, a biofilm composed of microorganisms called "denture plaque" rapidly develops upon insertion after cleansing[13]. There is a possibility that the denture plaque may reach the lungs by aspiration, causing aspiration pneumonia. Although generally included as a part of oral care[11], previous studies have not focused on denture cleaning alone. In addition, most of the previous studies on the relationship between oral hygiene and pneumonia were carried

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out in nursing homes and hospitals[14,15]. However, the risk of aspiration pneumonia is considered to be high in community-dwelling older adults. To the best of our knowledge, no study has investigated the association between denture cleaning and pneumonia among community-dwelling older adults. From a public health viewpoint, as the majority of older adults are community-dwellers and not institutionalized, the prevention of pneumonia among community-dwelling older adults is important. In this study, we investigate whether infrequent denture cleaning is associated with the risk of developing pneumonia among community-dwelling older adults.

Methods

Settings and participants. This cross-sectional study is based on a self-reported questionnaire. The data were obtained from the survey of the 2016 Japan Gerontological Evaluation Study (JAGES). JAGES targeted the community-dwelling older adults aged ≥65 years, who were not certified to be eligible for long term public care. Information on social, behavioral, and health factors were collected. JAGES in 2016 was conducted in 39 municipalities in Japan. The questionnaire was sent by post and was retrieved by mail.

Dependent variable. We used the self-reported incidence of pneumonia within the last one-year as a dependent variable. We asked the question "*Did you experience the following diseases within the last one year?*" Those who answered "*pneumonia*" were considered to be the individuals who suffered from pneumonia within the last one year.

Independent variable. We used the frequency of denture cleaning as an independent variable. To those who used removable dentures, we asked the question "*Do you clean your dentures daily?*"; the choices provided were "*Yes*" or "*No*." We defined people chose "*Yes*" as those who cleaned their denture daily and "*No*" as those who cleaned their dentures infrequently (non-daily).

Covariates. We selected possible cofounders as covariates based on previous studies and clinical knowledge[1,16,17]; this included age, sex, smoking status, educational status, equivalent income, number of teeth, activities of daily living (ADL), comorbidity related to stroke or dementia, and experience of pneumococcal vaccination within last five-year.

Statistical analysis. We estimated the propensity score for the independent variable. The stabilized average treatment effect (ATE) on the risk of pneumonia was calculated using the inverse probability weighting (IPW) method. To predict the propensity score for infrequent denture cleaning, we used the logistic regression model; all the covariates were included as possible confounders and the stabilized ATE weight was calculated. The stabilized ATE weight was used to avoid instability of the estimated effect size due to extreme weighting[18]. We compared the standardized difference between the categories of independent variable before and after stabilized ATE weighting[19,20]. The standardized difference was used to check the balance of the covariates between the treated and control groups. If standardized difference of all covariates was <0.1 after weighting, it was regarded as well balanced. We developed the logistic regression model; the odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated using IPW with stabilized ATE weights (stabilized ATE-IPW). For missing responses, we presumed that the missing pattern of the original data set was missing at random. Multiple imputation by chained equation (MICE) was used to generate 20 imputed datasets. We calculated the stabilized ATE weighted OR for each data set and combined all estimators by Rubin's rule[21]. In the sensitivity analysis, the participants were stratified into two age groups (<75 or ≥75 years) for IPW. Then, the interaction effect of age and frequency of denture cleaning was confirmed by using the relative excess risk due to interaction (RERI) as additive scales and the ratio of OR as multiplicative scale between them[22]. We used Stata/MP version 15 (Stata Corp., College Station, TX, USA) for statistical analysis.

Ethical issue. In this study, the process of obtaining informed consent was as follows: the questionnaire was sent by mail along with the explanation of the study; the participants read the written explanation about the aim of study and replied. Hence, we considered that informed consent was provided by those who replied and sent back the questionnaire. The JAGES protocol in 2016 was approved by the ethics committee of National Center for Geriatrics and Gerontology (No. 992) and the ethics committee of Chiba University (No. 2493). We followed the STROBE Statement to report our observational study.

Results

From a target population of 279,661, 180,021 individuals participated in the survey (response rate = 70.2%). Of these, 88,994 (49.4%) participants who used removable dentures (including both removable full/partial dentures) were included in this analysis. However, 17,767 participants with missing information regarding the dependent variable were excluded. Finally, data of 71,227 participants were included in the analysis. Table 1 shows the characteristics of the participants. The mean age was 75.2 years (SD = 6.5); 48.3% were male. Overall, 2.3% (n = 1,666) and 97.7% (n = 69,561) of the participants, respectively, did and did not experience pneumonia within the last one year.

Table 2 shows the proportion of participants who experienced pneumonia based on the frequency of denture cleaning and stratified by age group. Pneumonia was more prevalent among the participants who did not clean their dentures daily, especially those aged ≥75 years. Among these participants aged ≥75 years, 2.9% and 4.3% of those who did and did not clean their dentures daily, respectively, experienced pneumonia.

To reduce the possibility of selection bias, we estimated the propensity score for denture cleaning after MICE. After multiple imputation, the missing values of 22,020 participants were imputed. The propensity scores were predicted using the logistic regression model separately for the entire data (all participants) and stratified data (participants aged <75 years or ≥75 years) for each imputed data sets. After using stabilized ATE weight, the

Characteristics	All participants (n = 71,227)		Experienced pneumonia within last one-year (n = 1,666)		Not experienced pneumonia within last one-year (n = 69,561)	
	n	%	n	%	n	%
Frequency of denture cleaning						
Daily	67,208	94.4	1,547	92.9	65,661	94.4
Non-daily	3,293	4.6	100	6.0	3,193	4.6
Missing	726	1.0	19	1.1	707	1.0
Age						
65–69 years	16,770	23.5	248	14.9	16,522	23.8
70–74 years	18,579	26.1	365	21.9	18,214	26.2
75–79 years	17,347	24.4	425	25.5	16,922	24.3
80–84 years	11,858	16.6	369	22.2	11,489	16.5
≥85 years	6,673	9.4	259	15.6	6,414	9.2
Sex						
Male	34,393	48.3	984	59.1	33,409	48.0
Female	36,825	51.7	682	40.9	36,143	52.0
Missing	9	0.0	0	0.0	9	0.0
Education						
≤9 years	25,133	35.3	706	42.4	24,427	35.1
10–12 years	28,513	40.0	596	35.8	27,917	40.1
≥13 years	16,611	23.3	331	19.9	16,280	23.4
Missing	970	1.4	33	2.0	937	1.4
Equivalent income (100 JPY ≈ 1 USD)						
<1,000,000 JPY	7,568	10.6	230	13.8	7,338	10.6
1,000,0000–1,999,999 JPY	21,017	29.5	455	27.3	20,562	29.6
2,000,0000–2,999,999 JPY	13,401	18.8	274	16.5	13,127	18.9
3,000,0000–3,999,999 JPY	8,055	11.3	124	7.4	7,931	11.4
≥4,000,000 JPY	5,701	8.0	117	7.0	5,584	8.0
Missing	15,485	21.8	466	28.0	15,019	21.6
Smoking status						
Never	39,027	54.8	702	42.2	38,325	55.1
Quite	22,368	31.4	772	46.3	21,596	31.1
Current	8,726	12.3	145	8.7	8,581	12.3
Missing	1,106	1.5	47	2.8	1,059	1.5
Dementia						
Yes	484	0.7	16	1.0	468	0.7
No	68,468	96.1	1,620	97.2	66,848	96.1
Missing	2,275	3.2	30	1.8	2,245	3.2
Stroke						
Yes	2,197	3.1	76	4.6	2,121	3.1
No	66,755	93.7	1,560	93.6	65,195	93.7
Missing	2,275	3.2	30	1.8	2,245	3.2
Activities of daily living						
No need for personal assistance	63,052	88.5	1,300	78.0	61,752	88.8
Require some personal assistance	4,787	6.7	255	15.3	4,532	6.5
Missing	3,388	4.8	111	6.7	3,277	4.7
Number of teeth						
0	10,620	14.9	337	20.2	10,283	14.8
1–4	7,577	10.6	217	13.0	7,360	10.6
5–9	11,707	16.4	299	18.0	11,408	16.4
10–19	20,687	29.1	437	26.2	20,250	29.1
≥20	19,096	26.8	320	19.2	18,776	27.0
Missing	1,540	2.2	56	3.4	1,484	2.1
Experience of pneumococcal vaccination within last five-year						
Yes	30,174	42.4	1,016	61.0	29,158	41.9
No	39,349	55.2	565	33.9	38,784	55.8
Missing	1,704	2.4	85	5.1	1,619	2.3

Table 1. Characteristics of the participants (n = 71,227).

n (%)	All participants (n = 70,501)		65–74 years (n = 35,062)		≥75 years (n = 35,439)	
	Frequency of denture cleaning		Frequency of denture cleaning		Frequency of denture cleaning	
	Daily	Non-daily	Daily	Non-daily	Daily	Non-daily
Incidence of pneumonia within the last one year						
Yes	1,547 (2.3)	100 (3.0)	575 (1.7)	34 (1.9)	972 (2.9)	66 (4.3)
No	65,661 (97.7)	3,193 (97.0)	32,733 (98.3)	1,720 (98.1)	32,928 (97.1)	1,473 (95.7)

Table 2. The incidence of pneumonia within the last one year based on the frequency of denture cleaning stratified by age groups.

Frequency of denture cleaning	All participants (n = 71,227)	65–74 years (n = 35,349)	≥75 y (n = 35,878)
	Stabilized ATE weighted	Stabilized ATE weighted	Stabilized ATE weighted
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Daily	Ref.	Ref.	Ref.
Non-daily	1.30 (1.01–1.68)	0.98 (0.64–1.50)	1.58 (1.15–2.17)

Table 3. The association between the incidence of pneumonia within the last one year and the frequency of denture cleaning. *Note:* ATE = average treatment effect, OR = odds ratio, 95%CI = 95% confidence interval, Ref. = reference.

standardized differences of all covariates were <0.1 (Supplementary Table 1). Therefore, by using the estimated propensity score, we confirmed that the all the covariates are well balanced between those who did and did not cleaned their dentures daily. Table 3 shows the results of the logistic regression analysis using the stabilized ATE-IPW method; infrequent denture cleaning was significantly associated with the incidence of pneumonia among all participants (OR = 1.30, 95% CI = 1.01–1.68). In addition, the sensitivity analysis based on stratification by age groups showed that infrequent denture cleaning was significantly associated with the occurrence of pneumonia among those aged ≥75 years (OR = 1.58, 95% CI = 1.15–2.17). In contrast, a significant association between infrequent denture cleaning and the incidence of pneumonia was not observed among those aged <75 years (OR = 0.98, 95% CI = 0.64–1.50). However, the additive and multiplicative scale of interaction effect was not significant (Supplementary Table 2).

Discussion

The present study revealed that infrequent denture cleaning was associated with the incidence of pneumonia within the last one year among community-dwelling older adults. This result suggests the importance of denture cleaning in reducing the risk of pneumonia among community-dwelling older adults. From the public health viewpoint, this is an important finding because the number of community-dwelling older adults is increasing in this aging world.

As mentioned in the introduction, previous studies suggested that oral hygiene including denture cleaning was associated with the incidence of pneumonia among nursing homes residents[11]; the present study showed a similar association among the community-dwelling older adults. A study conducted in nursing home reported a reduction of death due to pneumonia among older residents by oral care including denture cleaning[23]. We added that frequent denture care could reduce the incidence of pneumonia in community-dwelling older adults.

Denture plaque is composed from many species of bacteria and fungus; some of them are regarded as pathogen of pneumonia[24,25]. Infrequent denture cleaning causes accumulation of denture plaque[26], and therefore, the possibility of the pathogens reaching the lung by aspiration might increase[27]. Consequently, it may be presumed that the pathogens from denture plaque accumulated due to infrequent cleaning were aspirated and may have increased the risk of pneumonia. In the present analysis, a strong association was observed among those aged ≥75 years, although a statistical significance was not clearly observed. With advancing age, the immune system declines[3] and aspiration is more likely to occur in older adults rather than those who are younger[28]. The mortality rate of pneumonia is increasing among the older adults[2]. Therefore, the results of the present study are reasonable: those aged ≥75 years were more likely to develop pneumonia and the harmful effect of infrequent denture cleaning was stronger than that observed in younger participants. These results are supported by the biological explanations mentioned above. Further study considering the effect modification of dysphagia on the association between poor oral hygiene and pneumonia incidence would strengthen our explanation of the results of the present study.

The strength of this study was the inclusion of over 70,000 participants; this sample size was large enough to detect the association between infrequent denture cleaning and pneumonia. The incidence of pneumonia among community-dwelling older adults is lower than that in nursing homes where frail older adults live[29]. Therefore, it is difficult to have sufficient statistical power to detect the association in smaller epidemiological studies. This study, however, has several limitations. As this was a cross-sectional study, we could not evaluate the causal relationship between denture cleaning and pneumonia. However, it is less likely that the occurrence of pneumonia would lead to infrequent denture cleaning. In addition, the self-reported incidence of pneumonia causes reporting bias. However, the incidence of pneumonia in this study is similar to that previously reported[30]. Therefore, the reporting bias caused by the self-reporting of pneumonia was considered to be relatively small.

The self-reported independent variable, denture cleaning, also created bias. A wide variety of denture cleaning methods and techniques may be used by the participants. Our questionnaire could not obtain information on the details regarding the denture cleaning methods. However, this reporting bias could widen the 95% confidence interval of our estimates. Despite this situation, there was a significant association of denture cleaning with pneumonia; therefore, we consider the present results to be robust. Furthermore, those who died because of pneumonia were not included in this study. This selection bias is considered to cause an underestimation of the association between denture cleaning and pneumonia. In the present results, the benefit of denture cleaning was remarkable among only older adults aged ≥75 years. The individuals who died from pneumonia are considered to be frail and very old[27,29]; therefore, the impact of denture cleaning on these individuals is larger than those who experienced pneumonia but are alive. The previous study revealed an association between denture wearing during sleep and pneumonia incidence among community-dwelling older adults[31]. The results of this previous study were similar to those from our study. There was a possibility of multicollinearity between denture wearing during sleep and infrequent denture cleaning. In our survey, a question about denture wearing during sleep was asked to only one-eighth of all participants (n = 8,316), so we did not include this variable in the present analysis to avoid decreasing the sample size. When analyzing this variable alone, we confirmed that the proportions of those wearing dentures during sleep were similar among those participants who did/did not clean their dentures daily (17.3% among those who cleaned their dentures daily and 18.5% among those who did not clean their dentures daily wore dentures during sleep; chi-square test, $p = 0.544$). Therefore, infrequent denture cleaning is associated with pneumonia incidence and is independent of denture wearing during sleep.

Conclusion

The present study revealed that infrequent denture cleaning was associated with the incidence of pneumonia within the last one year among community-dwelling older adults. Daily cleaning of dentures may reduce the risk of pneumonia among community-dwelling older adults. In the chair side, dental professionals need to instruct their patients to keep their dentures clean to prevent pneumonia. Even for community-dwelling older adults, dental professionals should pay more attention to oral hygiene for pneumonia prevention.

Data Availability

All data needed to evaluate the conclusions in the paper are present in the paper and/or the Supplementary Materials. The JAGES data used in this study will be made available upon request. The authors require the applicant to submit an analysis proposal to be reviewed by an internal JAGES committee to avoid duplication. Confidentiality concerns prevent us from depositing our data in a public repository. Proposals submitted by outside investigators will be discussed during the monthly investigators' meeting to ensure that there is no overlap with ongoing analyses. If approval to access the data is granted, the JAGES researchers will request the outside investigator to help financially support our data manager's time to prepare the data for outside use.

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Acknowledgements

This study used data from JAGES (the Japan Gerontological Evaluation Study), and this work was supported by MEXT(Ministry of Education, Culture, Sports, Science and Technology-Japan)-Supported Program for the Strategic Research Foundation at Private Universities (2009–2013), JSPS(Japan Society for the Promotion of Science) KAKENHI Grant Numbers (18390200, 22330172, 22390400, 23243070, 23590786, 23790710, 24390469, 24530698, 24683018, 25253052, 25870573, 25870881, 26285138, 26882010,15H01972, 18KK0057, 19H03860), Health Labor Sciences Research Grants (H22-Choju-Shitei-008, H24-Junkanki [Seishu]-Ippan-007, H24-Chikyukibo-Ippan-009, H24-Choju-Wakate-009, H25-Kenki-Wakate-015, H25-Choju-Ippan-003, H26-Irryo-Shitei-003 [Fukkou], H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001, H28-choju-Ippan-002, H28-Ninchisyou-Ippan-002, H30-Kenki-Ippan-006, H30-Junkankitou-Ippan-004), Japan Agency for Medical Research and development (AMED) (JP17dk0110017, JP18dk0110027, JP18ls0110002, JP18le0110009), the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29-42). The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Author Contributions

T.K.: conception and design. J.A.: conception and design, acquisition of data. T.Y., K.K., K.O.: acquisition of data. All authors: analysis and interpretation of data, drafting the article, critical revision and approval of final manuscript.

Additional Information

Supplementary information accompanies this paper at https://doi.org/10.1038/s41598-019-50129-9.

Competing Interests: The authors declare no competing interests.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

JDI Journal of Diabetes Investigation Open access
Official Journal of the Asian Association for the Study of Diabetes
ORIGINAL ARTICLE

Dementia risk by combinations of metabolic diseases and body mass index: Japan Gerontological Evaluation Study Cohort Study

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Keywords
Dementia, Metabolic diseases, Underweight

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J Diabetes Investig 2020; 11: 206–215

doi: 10.1111/jdi.13103

ABSTRACT

Aims/Introduction: To compare the dementia risk associated with pre-existing diabetes, hypertension, dyslipidemia, obesity (body mass index [BMI] ≥25 kg/m^2) and underweight (BMI <18.5 kg/m^2) among older adults. We also explored the dementia risk associated with combinations of metabolic diseases and BMI.

Materials and Methods: We used data from the Japan Gerontological Evaluation Study. Participants completed a health checkup in 2010 and were followed for 5.8 years on average. Dementia was measured by municipal long-term care insurance registration. Diabetes, hypertension, dyslipidemia, obesity and underweight were diagnosed by medication use or health examination results. We calculated the incidence of dementia and adjusted hazard ratios (HRs).

Results: Among 3,696 participating older adults, 338 developed dementia. Adjusted HRs (95% confidence intervals) in men and women (reference: those without corresponding disease of normal weight) were as follows: 2.22 (1.26–3.90) and 2.00 (1.07–3.74) for diabetes; 0.56 (0.29–1.10) and 1.05 (0.64–1.71) for hypertension; 1.30 (0.87–1.94) and 0.73 (0.49–1.08) for dyslipidemia; 0.73 (0.42–1.28) and 0.82 (0.49–1.37) for BMI of 25–29.9 kg/m^2; and 1.04 (0.51–2.10) and 1.72 (1.05–2.81) for underweight. Dementia risk was significantly higher in underweight men with dyslipidemia (HR 4.15, 95% CI 1.79–9.63) compared with normal-weight men without dyslipidemia, and in underweight women with hypertension (HR 3.79, 1.55–9.28) compared with normal-weight women without hypertension. Dementia incidence was highest among underweight older adults with hypertension followed by dyslipidemia.

Conclusions: Among Japanese older adults, underweight and prevalent diabetes are risk factors for developing dementia. Lower BMI is also associated with a higher incidence of dementia.

INTRODUCTION

Dementia is a prevalent disease in older adults worldwide[1]. Researchers have investigated the dementia risk related to metabolic diseases[2]. Diabetes is known to impair cognitive function through several mechanisms[3–8], and there is debate as to whether hypertension in late-life increases or decreases the incidence of Alzheimer's disease[9,10]. Hypercholesterolemia might be a risk factor for dementia in mid-life, but not in late life[11]. Although dementia risk might increase with overweight or obesity in mid-life (relative risk 0.99–2.44)[12], the estimated risk for dementia associated with obesity in late-life varies (relative risk 0.24–1.13)[12]. However, separating individual dementia risk factors might be difficult, because metabolic diseases and obesity frequently overlap in older adults.

Being underweight might also be a risk factor for a reduced lifespan[13]. The Rotterdam Study carried out in the Netherlands suggested that a body mass index (BMI)

Received 17 December 2018; revised 31 May 2019; accepted 13 June 2019

<18.5 kg/m^2 (underweight) in older adults increased mortality[14]. A USA study reported high mortality among residents aged ≥65 years who were underweight or had unintentional weight loss[15]. Korean[16] and Japanese[17] older adults with low to normal-to-low BMI might also be at risk for a shorter lifespan. However, little is known about dementia risk among underweight older adults.

Some Asian older adults are underweight because of undernutrition[18] and underexercising[19], which might result in a shorter lifespan. Although Asians tend to be slimmer than Caucasians[20], they have a similar prevalence of diabetes and dyslipidemia[8,21,22]. Analyses of dementia risk associated with metabolic diseases and BMI have been carried out separately. However, evaluation of the risk for dementia among people with coexisting metabolic diseases and obesity/underweight is required. The present study aimed to compare the dementia risk associated with diabetes, hypertension, dyslipidemia and BMI (obesity and underweight) in a Japanese cohort. We also aimed to clarify the combinations of metabolic disease and BMI that had the highest risk for developing dementia.

METHODS

Participants

In 2010, the Japan Gerontological Evaluation Study randomly selected community-dwelling adults aged ≥65 years who were not registered by municipalities at baseline as requiring care under the long-term care insurance (LTCI) system[23]. In Japan, adults with incident dementia at age ≥40 years are covered by LTCI[24]. The benefits of LTCI range from support need levels 1 and 2 to care need levels 1–5[25], with a higher level indicating more care is required. As we describe below, the primary outcome of the present study was LTCI registration, diagnosis of dementia and a ranking of independence in daily life of ≥2b. Although a small number of participating older adults might have had slightly impaired cognitive function[24] at baseline, most were considered not to have dementia.

The present study included a subset of participants from the Japan Gerontological Evaluation Study cohort who received municipal health checkups in 2010 and were followed up over several years (average 5.8 years). Participants in this study were residents of Tokoname City and Minamichita Town in Aichi Prefecture, Japan, which had approximately 59,000 and 18,000 residents in 2018, respectively. In the health checkups, trained nurses measured blood pressure, collected blood samples and interviewed participants regarding prescribed medications. Serum cholesterol and glycated hemoglobin A1c levels were measured using laboratory testing devices with every-morning calibrations. BMI was calculated as the participant's weight in kilograms divided by their height in meters squared.

The protocol for this research project was approved by the suitably constituted ethics committees of the study institutions, and conformed to the provisions of the Declaration of Helsinki (ethics committee of the Chiba University School of Medicine, approval no. 2493; the ethics committee of the University of Yamanashi School of Medicine, approval no. 18150). Informed consent was obtained from all participants and/or their legal guardian(s). Data for participating older adults were anonymously analyzed and reported.

Measurements

Since 2000, all Japanese people aged ≥40 years have been required to pay a premium for coverage under the LTCI system[26]. This meant that they would be eligible for insurance benefits if they required long-term care, including dementia care[27]. When people need dementia care under this system, they are required to submit documentation prepared by a medical doctor and a LTCI certification investigator (accredited by the prefecture) who visit the older adult's home. These documents record dementia diagnosis and score for independence in daily life, which is ranked as 1, 2a, 2b, 3a, 3b, 4 or M; a higher rank indicates more dependence on others for assistance. For example, rank 2a indicates that the person has difficulty in daily life with symptoms, behaviors and communication outside the home (e.g., they might frequently lose their way or make mistakes with payments), but can lead an independent life with some care and support. If the difficulties described in rank 2a are both outside and inside the home, the person would be ranked 2b. Rank 4 indicates the older adult requires constant care. Therefore, we defined patients with dementia as those who had started to receive the LTCI benefit and were ranked from 2a to 4 as the outcome for the time-to-event analysis. Rank M indicates that people require specialized medical care for severe psychiatric symptoms, problematic behaviors or severe physical disorders; few people are certified with this rank, and we could not measure and include rank M as an outcome in the present study.

Health examinations that participants received in their municipalities were carried out by medical staff in medical institutions. We extracted data for diabetes, hypertension, dyslipidemia, underweight and obesity from the results of these examinations. Diabetes was defined as receiving the relevant medication or glycated hemoglobin A1c ≥6.5% (48 mmol/mol) according to a recommended guideline for epidemiological studies[28]. Hypertension was defined as receiving medication, systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg[29]. Dyslipidemia was defined as receiving medication, serum low-density lipoprotein cholesterol ≥140 mg/dL, high-density lipoprotein cholesterol <40 mg/dL or triglyceride ≥150 mg/dL[30]. BMI was categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2) or obese (≥25 kg/m^2), according to the recommended cut-off values for Japan[31,32]. When the sample size was sufficient for analysis, we further divided the obesity range to 25–29.9 kg/m^2 (obesity grade 1) or ≥30 kg/m^2 (obesity grades 2–4)[31,32].

Statistical analysis

We described participants' baseline characteristics using means (standard deviations [SD]) or numbers (percentages for proportions). We calculated hazard ratios (HR) with 95% confidence intervals (CI) for developing dementia for those with diabetes, hypertension, dyslipidemia, obesity and underweight stratified by sex. The HRs were adjusted for age, history of stroke, educational background, income, number of family members, marital status and frequency of meeting friends. As a sensitivity analysis, we carried out this analysis excluding the explanatory variable of history of stroke. We also calculated crude HRs for combinations of three metabolic diseases and BMI. In calculating HRs, participants who were lost to follow up were treated as censored data. Because dementia development was relatively common among underweight older adults, we calculated the dementia incidence rate (100 person-years) in those with and without diabetes, hypertension, and dyslipidemia to explore the profile with the highest risk. We also presented the incidence of dementia for combinations of three metabolic diseases and BMI. In this analysis, we calculated the *P*-value for trend for the association between BMI and total incidence of dementia, and that in each metabolic disease profile. Participants who had all data for the explanatory and response variables, and censored time were included in the analyses. All statistical analyses were carried out with SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Descriptive statistics were reported as means and SDs. We used the SAS PROC PHREG procedure to calculate HRs. All reported *P*-values were two-sided; *P*-values < 0.05 were considered statistically significant.

RESULTS

Table 1 shows the baseline characteristics of participants who were followed up. In total, there were 3,696 participants (42.8% men); 338 developed dementia. Participants' mean age at baseline was 73.4 years (SD 5.8 years), and the mean follow-up duration was 5.8 years (SD 1.3 years). Dyslipidemia was the most common and obesity the second most common among three metabolic diseases and BMI abnormalities (obesity and underweight).

Table 2 shows the HRs for developing dementia with diabetes, hypertension, dyslipidemia, obesity and underweight by sex. Men and women with diabetes had a statistically significant doubled risk for dementia compared with those without diabetes. Underweight women had a HR for dementia of 1.72 compared with those with normal weight, and this result was statistically significant. None of the covariates for adjustment were significantly associated with the incidence of dementia. In the sensitivity analysis excluding the explanatory variable of history of stroke, HRs (95% CIs) in men and women were as follows: 2.21 (1.26–3.88) and 2.00 (1.07–3.74) for diabetes; 0.65 (0.35–1.23) and 1.02 (0.62–1.66) for hypertension; 1.31 (0.88–1.95) and 0.72 (0.49–1.07) for dyslipidemia; 0.90 (0.12–6.52) and 0.62 (0.09–4.44) for BMI $\geq$30 kg/m^2; 0.74 (0.42–1.28) and 0.81 (0.49–1.36) for BMI 25–29.9 kg/m^2; and 1.04 (0.51–2.1) and 1.73 (1.06–2.83) for BMI <18.5 kg/m^2, respectively.

Table 3 shows the HRs for dementia in various combinations of metabolic diseases and body types stratified by sex. In brief, there was a statistically significant large HR in underweight men with dyslipidemia (HR 4.15, 95% CI 1.79–9.63) compared with normal-weight men without dyslipidemia. In addition, the large HR for underweight women with hypertension (HR 3.79, 95% CI 1.55–9.28) was statistically significant compared with normal-weight women without hypertension.

Table 4 shows the incidence rate for combinations of metabolic diseases and BMI. The highest incidence was in underweight participants with hypertension, followed by underweight participants with dyslipidemia. There were statistically significant trends of lower BMI and a higher incidence of dementia in all participants, and in those without diabetes, with hypertension, without hypertension, with dyslipidemia and without dyslipidemia.

Table 5 shows the results of Table 4 stratified by sex. There were statistically significant trends of lower BMI and a higher incidence of dementia in both sexes, and in men and women without diabetes, women with hypertension, men and women without hypertension, men and women with dyslipidemia, and men and women without dyslipidemia.

DISCUSSION

The present study showed that among older adults with metabolic diseases and body types, those with diabetes had the highest HR for dementia (Table 2). Among the various metabolic disease and body type profiles, underweight participants with hypertension had the highest incidence of dementia, followed by underweight participants with dyslipidemia (Table 4). In the combinations of metabolic disease and body type by sex, the highest HR was found in underweight men with dyslipidemia, followed by underweight women with hypertension (Table 3). Among all participants, lower BMI was associated with a higher incidence of dementia (Tables 4,5).

Previous research has shown that prevalent diabetes increased the risk for dementia, and one-third of general older adults have cerebrovascular amyloidosis[33]. In a mouse model, amyloidosis manifested significantly in mice with diabetes compared with those without diabetes[34]. Epidemiological studies have shown that people with diabetes are at 1.5–1.7-fold greater risk for dementia than people without diabetes[2,35]. Presumed mechanisms for the high dementia incidence in patients with diabetes include oxidant stress from steep glycemic excursion and production of reactive oxygen species[4], reduction of insulin transportation to the brain[5,7], inflammation of cerebral tissue, reduction of insulin signaling[6], and atherosclerosis from hypertension and hypercholesterolemia[8]. Consistent with previous studies, participants with diabetes in the present study had a doubled risk for dementia (Table 2). These data suggest that controlling diabetes in older adults would contribute to reducing the risk for dementia.

Table 1 | Baseline characteristics of participating Japanese older adults who were followed up in this study

Baseline characteristics of followed older adults	Men (n = 1,582)	Women (n = 2,114)
Age, years (mean ± SD)	73.4 ± 5.7	73.5 ± 5.8
BMI ≥30 kg/m^2, n (%)	20 (1.3)	49 (2.3)
BMI 25–29.9 kg/m^2, n (%)	336 (21.2)	417 (19.7)
BMI 18.5–24.9 kg/m^2, n (%)	1,134 (71.7)	1,462 (69.2)
BMI ≤18.4 kg/m^2, n (%)	92 (5.8)	186 (8.8)
Diabetes, n (%)	146 (9.2)	127 (6.0)
Hypertension, n (%)	277 (17.5)	389 (18.4)
Dyslipidemia, n (%)	752 (47.5)	961 (45.5)
Medication for diabetes, n (%)	51 (3.2)	40 (1.9)
Medication for hypertension, n (%)	201 (12.7)	282 (13.3)
Medication for dyslipidemia, n (%)	73 (4.6)	150 (7.1)
History of stroke, n (%)	32 (2.0)	19 (0.9)
Dementia, n (%)	131 (8.3)	207 (9.8)
Follow-up duration, years (mean ± SD)	5.7 ± 1.4	5.9 ± 1.2

BMI, body mass index; SD, standard deviation.

Table 2 | Hazard ratios (95% confidence intervals) for dementia in older adults with diabetes, hypertension, dyslipidemia, obesity and underweight

Metabolic disease	Univariate	Adjusted in model 1†	Adjusted in model 2†
Men			
Diabetes	1.42 (0.84–2.39)	1.72 (1.01–2.90)	2.22 (1.26–3.90)
Hypertension	0.74 (0.45–1.22)	0.63 (0.37–1.07)	0.56 (0.29–1.10)
Dyslipidemia	1.09 (0.77–1.53)	1.36 (0.96–1.93)	1.30 (0.87–1.94)
BMI ≥30 kg/m^2	0.58 (0.08–4.12)	0.66 (0.09–4.72)	0.91 (0.13–6.64)
BMI 25–29.9 kg/m^2	0.62 (0.38–1.02)	0.72 (0.44–1.18)	0.73 (0.42–1.28)
BMI 18.5–24.9 kg/m^2	Ref	Ref	Ref
BMI <18.5 kg/m^2	1.64 (0.90–2.98)	0.95 (0.52–1.75)	1.04 (0.51–2.10)
Women			
Diabetes	1.76 (1.11–2.79)	2.16 (1.36–3.44)	2.00 (1.07–3.74)
Hypertension	1.00 (0.70–1.42)	1.10 (0.77–1.58)	1.05 (0.64–1.71)
Dyslipidemia	0.68 (0.51–0.90)	0.88 (0.66–1.18)	0.73 (0.49–1.08)
BMI ≥30 kg/m^2	0.63 (0.20–1.99)	0.85 (0.27–2.66)	0.61 (0.09–4.43)
BMI 25–29.9 kg/m^2	0.75 (0.51–1.11)	0.81 (0.55–1.19)	0.82 (0.49–1.37)
BMI 18.5–24.9 kg/m^2	Ref	Ref	Ref
BMI <18.5 kg/m^2	1.99 (1.35–2.92)	1.52 (1.03–2.24)	1.72 (1.05–2.81)

†Model 1 adjusted for age and history of stroke; model 2 adjusted for model 1 plus educational background, income, number of family members, marital status and frequency of meeting friends. BMI, body mass index.

The present study also showed that underweight women were at risk for dementia (Table 2). We further analyzed our data to answer the question, "Which groups of underweight individuals with comorbid metabolic diseases suffer from dementia?" (Table 3). The results suggested that underweight men with dyslipidemia and underweight women with hypertension had a higher risk for dementia. These older adults might therefore need to be targeted for interventions for metabolic diseases to reduce dementia risk.

Reasons for older adults being underweight might include combinations of shortage of food intake, underexercising, digestion and absorption disorders, loss of teeth, endocrinological diseases, and debilitating diseases (e.g., cancer or infection)[36]. In particular, undernutrition among older adults has been recognized as a major reason for decline in muscle mass and weight[37]. A previous study showed that muscle-releasing hormones (myokines) played an important role in recovery of injured brain tissue, and exercise improved cognitive performance[38]. The high risk for dementia among those with low BMI in the present study emphasized the importance of maintaining muscle mass to preserve cognitive function[39]. This suggests that it might be important to encourage older adults to consume more protein than younger to middle-aged adults[40].

Table 3 | Hazard ratios for dementia in older adults with combinations of diabetes, hypertension, dyslipidemia, obesity, and underweight

DM	HT	DL	BMI	No.†	vs	DM	HT	DL	BMI	No.†	HR (95% CI)
Men											
(+)			Obese	5/48	vs	(–)			NW	88/1,038	1.17 (0.48–2.89)
(+)			Underweight	0/2	vs	(–)			NW	88/1,038	–‡
	(+)		Obese	3/85	vs		(–)		NW	84/948	0.38 (0.12–1.21)
	(+)		Underweight	0/6	vs		(–)		NW	84/948	–‡
		(+)	Obese	17/228	vs			(–)	NW	57/629	0.80 (0.47–1.38)
		(+)	Underweight	6/19	vs			(–)	NW	57/629	4.15 (1.79–9.63)
(+)	(+)		Obese	1/16	vs	(–)	(–)		NW	77/800	0.94 (0.24–3.72)
(+)	(+)		Underweight	0/1	vs	(–)	(–)		NW	77/800	–‡
(+)		(+)	Obese	4/37	vs	(–)		(–)	NW	51/576	1.34 (0.53–3.38)
(+)		(+)	Underweight	0/0	vs	(–)		(–)	NW	51/576	–‡
	(+)	(+)	Obese	3/67	vs		(–)	(–)	NW	50/549	0.43 (0.14–1.39)
	(+)	(+)	Underweight	0/0	vs		(–)	(–)	NW	50/549	–‡
(+)	(+)	(+)	Obese	1/15	vs	(–)	(–)	(–)	NW	47/509	–‡
(+)	(+)	(+)	Underweight	0/0	vs	(–)	(–)	(–)	NW	47/509	–‡
Women											
(+)			Obese	5/39	vs	(–)			NW	126/1,384	1.37 (0.56–3.35)
(+)			Underweight	0/10	vs	(–)			NW	126/1,384	–‡
	(+)		Obese	4/112	vs		(–)		NW	112/1,204	0.37 (0.14–1.01)
	(+)		Underweight	5/19	vs		(–)		NW	112/1,204	3.79 (1.55–9.28)
		(+)	Obese	15/249	vs			(–)	NW	89/803	0.52 (0.30–0.91)
		(+)	Underweight	9/53	vs			(–)	NW	89/803	1.68 (0.85–3.34)
(+)	(+)		Obese	0/11	vs	(–)	(–)		NW	102/1,051	0.52 (0.11–2.40)
(+)	(+)		Underweight	0/2	vs	(–)	(–)		NW	102/1,051	0.74 (0.24–2.33)
(+)		(+)	Obese	2/21	vs	(–)		(–)	NW	79/768	0.74 (0.24–2.33)
(+)		(+)	Underweight	0/2	vs	(–)		(–)	NW	79/768	–‡
	(+)	(+)	Obese	3/94	vs		(–)	(–)	NW	75/718	0.30 (0.11–0.83)
	(+)	(+)	Underweight	2/8	vs		(–)	(–)	NW	75/718	2.69 (0.91–7.91)
(+)	(+)	(+)	Obese	0/9	vs	(–)	(–)	(–)	NW	67/691	0.24 (0.01–4.67)
(+)	(+)	(+)	Underweight	0/0	vs	(–)	(–)	(–)	NW	67/691	–‡

†Number of dementia onset/number of aged adults at risk. ‡Hazard ratio could not be calculated because of the small sample size. Hazard ratios for dementia in older adults with one to several metabolic disease(s) were provided, compared with normal-weight older adults without corresponding metabolic disease(s), shown as (–). BMI, body mass index; CI, confidence interval; DL, dyslipidemia; DM, diabetes mellitus; HR, hazard ratio; HT, hypertension; NW, normal weight. Obese, body mass index ≥25 kg/m^2; normal weight, body mass index 18.5–24.9 kg/m^2; underweight, body mass index <18.5 kg/m^2.

Table 4 | Incidence of dementia (per 100 person-years) among older adults stratified by body mass index and disease

BMI (kg/m^2)	<18.5 (n = 278)	18.5–24.9 (n = 2,596)	25.0–29.9 (n = 735)	≥30.0 (n = 69)	P for trend
All	2.92	1.58	1.11	0.99	<0.0001
DM (+) (n = 273)	0	2.71	1.91	1.92	0.36
DM (–) (n = 3,423)	3.05	1.51	1.02	0.85	<0.0001
HT (+) (n = 666)	4.08	1.70	0.65	0	0.0002
HT (–) (n = 3,030)	2.82	1.56	1.25	1.36	0.0005
DL (+) (n = 1,713)	3.88	1.38	1.18	0.48	0.0015
DL (–) (n = 1,983)	2.59	1.75	1.01	1.54	0.0011

BMI, body mass index; DL, dyslipidemia; DM, diabetes mellitus; HT, hypertension.

Among the disease and body type profiles investigated, there was a significant increase in dementia in underweight women with hypertension (Tables 3,5). Reportedly, the BMI of Swedish women with ε4 allele of the apolipoprotein E gene (ApoE4$^+$), a major risk factor for Alzheimer's disease, declined after age 70 years[41]. This allele has also been associated with aortic

Table 5 | Incidence rate of dementia (per 100 person-years) among older adult men and women stratified by body mass index and non-communicable diseases

BMI (kg/m^2)	<18.5	18.5–24.9	25.0–29.9	≥30.0	*P* for trend
Men (*n*)	448	1,582	356	20	
All	2.44	1.52	0.96	0.88	0.004
DM (+) (*n* = 146)	0.00	2.11	1.86	0.00	0.36
DM (–) (*n* = 1,436)	2.51	1.47	0.82	1.04	0.002
HT (+) (*n* = 277)	0.00	1.41	0.65	0.00	0.12
HT (–) (*n* = 1,305)	2.62	1.55	1.05	1.41	0.013
DL (+) (*n* = 752)	6.30	1.45	1.35	0.00	0.020
DL (–) (*n* = 830)	1.52	1.58	0.28	2.61	0.029
Women (*n*)	186	1,462	417	49	
All	3.15	1.63	1.23	1.04	0.0002
DM (+) (*n* = 127)	0.00	3.42	1.99	2.88	0.45
DM (–) (*n* = 1,987)	3.35	1.55	1.16	0.78	<0.0001
HT (+) (*n* = 389)	5.54	1.91	0.65	0.00	0.0004
HT (–) (*n* = 1,725)	2.92	1.57	1.41	1.35	0.008
DL (+) (*n* = 961)	3.09	1.32	1.02	0.75	0.013
DL (–) (*n* = 1,153)	3.18	1.88	1.48	1.28	0.007

BMI, body mass index; DL, dyslipidemia; DM, diabetes mellitus; HT, hypertension.

stenosis[42]. The Rotterdam Study showed that residents with an abnormal increase in blood pressure from approximately age 55 years had a higher risk for future stroke[43]. In a USA study of aged adults, hetero- or homozygous ε4 allele(s) were detected in 38.7% of patients with Alzheimer's disease, 44.8% of those with cerebrovascular dementia and 24.1% of people without dementia. The present study did not identify Alzheimer's disease and ApoE4$^+$. However, we presume that this allele might have influenced the correlations among the decline in BMI, increase in blood pressure and high dementia risk.

In the present study, underweight men with dyslipidemia were also at a statistically significant high risk for dementia (HR 4.15, 95% CI 1.79–9.63; Table 3). However, some participants with dyslipidemia had received medications from mid- or late-life, whereas others had not received pharmacological interventions. A previous meta-analysis showed that statin use had a risk reduction of 38% and 24% in dementia and Alzheimer's disease, respectively[44]. This might suggest that early pharmacological intervention for middle-aged adults with dyslipidemia should be encouraged. With regard to high serum cholesterol levels, diet-induced hypercholesterolemia in white rabbits showed increased levels of brain amyloid beta protein and apolipoprotein E (clinical manifestations of Alzheimer's disease)[45]. A Finnish epidemiological study showed that hypercholesterolemia in mid-life was an independent risk factor for Alzheimer's disease[46]. However, there is no evidence that Japanese underweight older men have a high probability of untreated dyslipidemia. Dyslipidemia might contribute to dementia related to both Alzheimer's disease and stroke.

The present results showed that other than diabetes, no metabolic disease consistently presented a high risk for dementia (Tables 2,3). Epidemiological evidence suggests that metabolic syndrome might be an independent risk factor for dementia[47,48]. Accumulation of obesity, hypertension and hypercholesterolemia in mid-life increases the risk for dementia[49]. However, few studies have compared the risk for dementia in late-life in people with obesity versus non-obesity. The results of two USA studies investigating this topic were inconsistent[50,51], and another recent USA study suggested that higher late-life BMI was associated with a lower risk for dementia[52]. The present study investigating Japanese older adults showed that being underweight in late-life was a risk factor for dementia, whereas obesity was not (Table 5).

Hypertension in late-life is a risk factor for stroke and therefore cerebrovascular dementia, and was previously suspected to be a risk factor for Alzheimer's disease[53]. However, a recent systematic review did not detect late-life hypertension as a risk factor[9]. There is some consensus from diverse epidemiological results that hypercholesterolemia in mid-life might be an independent risk factor for Alzheimer's disease[54]. Literature suggests that ApoE4$^+$ might increase the serum lipid level[55]. However, evidence for the association between late-life dyslipidemia and dementia incidence is scarce. The present study concluded that hypertension and dyslipidemia in late-life were not consistent risk factors for dementia in all older adults (underweight to obese; Tables 2,5).

We found that obese women with dyslipidemia, and with dyslipidemia and hypertension were at statistically significant low risks for dementia (HR 0.52, 95% CI 0.30–0.91; HR 0.30, 95% CI 0.11–0.83, respectively; Table 3).The present results for separate metabolic diseases or BMI categories (Table 2) showed that obesity, hypertension and dyslipidemia were not risk or protective factors for dementia in women in late-life. The reason for the low HR (0.52) in women with obesity and

dyslipidemia is unknown. However, as the metabolic disease groups included participants who could afford medical care expenses for those diseases, Japanese older adult women with obesity might have a higher level of education[56] and a sufficient diet, and therefore good health status.

Adjusted HRs (Table 2) of diabetes for dementia in men (2.22, 95% CI 1.26–3.90) versus women (2.00, 95% CI 1.07–3.74) were similar, whereas the HR and incidence of underweight were higher in women (1.72, 95% CI 1.05–1.81) than in men (1.04, 95% CI 0.51–2.10). The present data also suggested that there was a higher incidence of dementia in women not with diabetes or dyslipidemia, but with hypertension (Table 5). The frequency of ApoE4^{+} appeared to be similar between Japanese men and women[57]. Worldwide, the incidence of Alzheimer's disease is considered to be similar between the sexes[58]. However, the incidence of Alzheimer's disease tends to be higher in women in Japan, although vascular dementia is similar in both sexes, as men die at a faster rate with aging[59]. The reasons for our finding of a higher dementia risk among underweight women are likely to be complex. For example, there are neuroanatomical, neurochemical, psychological, behavioral and cognitive differences between the sexes[58]. The susceptibility to risk factors for dementia might also differ between the sexes[60]. The design of the present study did not elucidate underlying reasons for the high incidence of dementia among underweight women with and without cardiometric factors.

Social role might also affect the difference between men and women in terms of the relationship between underweight and dementia. When older adult women experience decreased cognitive function, there might be a corresponding loss of a balanced healthy diet. In Japan, women are traditionally expected to cook meals for their families[61]. Therefore, it is likely that older adult men with dementia who have a spouse might have a good diet, whereas older adult women with dementia (with and without a spouse) might not have a healthy diet. A limitation of the present cohort study was that it was difficult to strictly exclude people with dementia from the baseline participants. The significantly larger HR (1.72) for underweight and dementia onset in women (Table 2) might reflect this situation. Furthermore, it might be less effective for health professionals to recommend protein intake and exercise to prevent sarcopenia and dementia progression for Japanese women with mild dementia.

Older adults tend to have decreased digestion and absorption capacity[36,62]. Without sufficient protein intake and exercise, they are prone to lose muscle mass[63]. Underweight is also considered to reflect inactivity, frailty and sarcopenia, which is defined as age-related decline of skeletal muscle, muscle strength and physical performance[64,65]. The present results showed that older underweight women were at a high risk for dementia (Table 2). It might be important to recommend exercise for older adults to better control comorbid metabolic diseases, and reduce the risk for dementia[9], coronary heart disease, stroke, type 2 diabetes and several forms of cancer[66].

People are becoming increasingly concerned about modifying obesity to prevent non-communicable diseases and cancer[67]. For older adults, major health outcomes are longevity and a healthy lifespan. Because older adults are vulnerable to illness, and have high mortality and weak organs, guidelines for disease prevention and management for middle-aged adults have recently been customized for older adults[29,30,68–73]. However, we consider that medical guidelines for older adult patients with various metabolic and debilitating diseases require systemic evaluation, so that mortality risk from reducing a single disease does not increase other mortality risks. Dementia[74], sarcopenia and frailty[75] present major mortality risks for older adults. Many guidelines for the prevention or management of diseases require health professionals to intervene with older adults based on their disease profiles. Furthermore, health professionals need to support their patients individually to accomplish longer healthy lifespans, consistent with the recommendations of various medical guidelines.

The present study had several strengths. First, metabolic diseases were identified in medical examinations, and the diagnostic standards applied in this study were based on guidelines used by medical doctors. Second, the sample size was relatively large, especially in the Japanese context where databases for usual medical treatment, municipal health examinations and long-term care for older adults are not usually linked. The linking of these databases enabled us to compare the risk for dementia among older adults with several metabolic diseases and different BMI groups, and evaluate which groups were at the highest risk (Tables 2,4,5). Further analyses with these linked databases are required to support the present results.

The present study also had several limitations. First, the endpoint (dementia) was gathered from municipal LTCI registrations, and it is possible that not all older adults with dementia applied to receive the LTCI benefit. As described in the Methods section, older adults with slightly impaired cognitive function might have been included as participants at baseline. However, as dementia progresses, patients tend to require support and it is therefore likely that patients or their caregivers would have applied for long-term care. Although this measurement of dementia onset might have been indirect, we consider that most cases of dementia onset were detected in this cohort. Second, the primary cause of dementia was not measured. For example, the etiology of cerebrovascular dementia differs from that of Alzheimer's disease, and the respective risk factors would be different. Third, the sample population was older adults living in two municipalities, and the results might not be generalizable. Fourth, it is possible that some older adults who were underweight at baseline were already mildly demented, and this might have impacted our findings. Fifth, the amount of muscle mass was not evaluated. A meta-analysis of randomized controlled trials of healthy older adults showed that exercise assisted in preserving reasoning ability[76]. Measurement of muscle mass is therefore likely to have improved the interpretation of the present results. Sixth, longitudinal changes in

metabolic disease profiles were not measured and built into the analyses. Finally, we did not adjust for risk factors for dementia other than history of stroke and metabolic status. However, we believe that overadjustment with many covariates would have biased the results, as would underadjustment. In addition, all cohort studies have such bias.

In conclusion, in a Japanese older adult population, being underweight and prevalent diabetes might be risk factors for dementia. Clinicians need to evaluate the reasons for their patients being underweight, and provide interventions according to their disease profiles.

ACKNOWLEDGMENTS

We express our deep gratitude to the participating residents and local government employees who cooperated in this study. We also thank the researchers who collected and organized the data; Dr Mie Mochizuki at the Department of Pediatrics, University of Yamanashi, who participated in the discussion of this manuscript; and Ms Audrey Holmes, MA, for editing a draft of this manuscript. This study used data from the Japan Gerontological Evaluation Study (JAGES), which was supported by the Japan Society for the Promotion of Science KAKENHI Grant Numbers (JP25253052 and JP18K17376) and Health Labor Sciences Research Grants (H28-Choju-Ippan-002 and H30-Junkankito-Ippan-004).

DISCLOSURE

The authors declare no conflict of interest.

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A prospective study of knee pain, low back pain, and risk of dementia: the JAGES project

Received: 18 March 2019
Accepted: 9 July 2019
Published online: 23 July 2019

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The aim of this prospective study was to investigate the associations of knee and low back pain with dementia development. Participants were 14,627 older people with no history of stroke, cancer, injuries, depression, Parkinson's disease, or dementia who did not require support for daily living completed self-administered questionnaires with 3-years follow-up. A Cox regression model was used to calculate hazard ratios (HRs) and 95% confidence intervals (CIs) for dementia development. Stratified analyses by age and regular walking were conducted. Dementia risk was higher in participants aged 65–79 years with knee pain and without low back pain than in those without knee and low back pain [HR: 1.73 (95% CI: 1.11–2.68)]. Dementia risk was lower in participants ≥80 years with low back pain but no knee pain than in those without low back or knee pain [HR: 0.50 (95% CI: 0.31–0.80)]. Participants with knee pain who did not walk regularly had the highest dementia risk [HR: 1.71 (95% CI: 1.26–2.33)]. Knee pain may increase dementia risk among individuals aged 65–79 years, and may further increase risk in non-regular walkers. Low back pain may be a marker of maintained cognitive function despite age for individuals ≥80 years.

Pain is a major cause of reduced activities of daily living (ADL)[1], which can increase dementia risk among older people. Thus, pain may be a dementia risk factor. However, previous study findings on pain and dementia are inconsistent. A prospective cohort study in the United States identified persistent pain as a risk factor for cognitive impairment and dementia[2], whereas pain was not associated with cognitive decline among older people in a prospective cohort study in the United Kingdom[3].

To explain this inconsistency, it may be useful to consider pain sites. Although both knee pain and low back pain can reduce ADL, they may differentially affect cognitive functions, and an investigation of the associations between knee/low back pain and dementia risk may be useful for dementia prevention. The only previous study on pain sites reported that osteoarthritis (OA) was independently associated with increased risk of dementia development[4]. However, the study did not consider physical activities or psychosocial factors, which are important for dementia development. Furthermore, no studies have investigated the association between low back pain and dementia risk.

Therefore, the aim of this Japanese prospective cohort study was to examine the associations of knee pain and low back pain with dementia development, considering physical activities, psychosocial factors, and differences in underlying mechanisms of knee/low back pain.

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Methods

Study population. We mailed self-administered questionnaires to older residents (aged ≥65 years) identified from official residential registers of 30 local governments throughout Japan at baseline in 2013. The questionnaires assessed the experience of knee pain and low back pain. Participation was voluntary. The response rate was 71.5%, which is comparable to other surveys of community-dwelling residents. Respondents were linked to the national long-term care insurance registry, which includes information about cognitive impairment based on in-home assessment by trained investigators (e.g. public health nurses)[5]. Under the Long-Term Care Insurance Act, all local governments in Japan retain data on cognitive impairment for all applicants of the national long-term care program.

We identified 17,290 participants who completed the questionnaires and did not received benefits from the national long-term care insurance at baseline. We excluded 1,745 participants with a history of stroke, cancer, injuries, depression, or Parkinson's disease, dementia at baseline, and we also excluded 918 participants who reported a need for support for daily living or who had missing ADL data. Data from 14,627 participants were analysed. None of the participants had a documented disability.

Knee pain and low back pain. We used two simple sequential yes/no questions to detect knee pain and low back pain.

Knee pain. "Have you had any pain around your knee during the last year? (yes)" and "Has your knee pain interfered with your daily activities? (yes)" defined knee pain.

Low back pain. "Have you had any pain around your low back during the last year? (yes)" and "Has your low back pain interfered with your daily activities? (yes)" defined low back pain.

Adjusted variables. *Demographic factors.* These were age (65–69, 70–74, 75–79, 80–84, or ≥85 years), sex, body mass index (10 percentiles), alcohol consumption (non-drinker, ex-drinker, or drinker), smoking (non-smoker, ex-smoker, or smoker), and history of diabetes mellitus and hypertension (yes or no).

The following single questions were used to measure drinking and smoking status: "Do you drink alcohol? –'Yes', 'Ceased drinking', or 'No'" and "Do you smoke? –'Yes', 'Ceased smoking', or 'No.'"

Socioeconomic factors. Education (<6 years, 6 to <9 years, 9 to <12 years, or ≥12 years), marital status (married, divorced, single, widowed, or other), income divided into quartiles of equivalised income in 2012, including tax: Q1 (men <1.31; women <1.23), Q2 (men 1.31–1.93; women 1.23–1.70), Q3 (men 1.94–2.46; women 1.71–2.46), Q4 (men 2.47–3.19; women 2.47–3.20), and Q5 (men >3.19; women >3.20) million Japanese yen [JPY]), employment status (employee, retired, or unemployed), loss events (loss of spouse, family member, close friend, or relative; yes or no), frequency of social interaction (≥4 per week, 2–3 per week, once a week, 1–3 per month, several times per year, or never), and frequency of going out (≥4 per week, 2–3 per week, once a week, 1–3 per month, several times per year, or never). Equivalised income was calculated by dividing the median value of the multiple-choice annual household income by the square root of the number of people living together. The annual household income question had 15 categories (<0.5, 0.5–0.9, 1–1.4, 1.5–1.9, 2.0–2.4, 2.5–2.9, 3.0–3.9, 4.0–4.9, 5.0–5.9, 6.0–6.9, 7.0–7.9, 8.0–8.9, 9.0–9.9, 10.0–11.9, and >11.9 million JPY). We defined low income as less than 1.22 million JPY of equivalised income above the poverty line in Japan in 2015[6].

Psychological factor. Mood or anxiety disorder (yes or no). When participants had 13 points or more in the Kessler Psychological Distress Scale (K6), they were considered to have mood or anxiety disorder[7].

Others. We additionally adjusted for knee pain or low back pain when we used low back pain or knee pain as a main exposure, respectively.

Definition of dementia development. We used data from a standardized in-home assessment carried out under the national long-term care insurance scheme established in 2000[5]. The primary assessment was conducted for applicants of the long-term care program by trained investigators dispatched from the certification committee in each municipality. During home visits, each applicant was assessed on their ADL and instrumental ADL status, cognitive function (e.g. short-term memory, orientation, and communication) and the presence of mental and behavioural disorders using a standardized government assessment manual[8].

Cognitive disability grade was categorized into eight levels: 0, I, IIa, IIb, IIIa, IIIb, IV, and M (0 = Independent, M = Needs constant treatment in a specialized medical facility). This cognitive impairment categorization strongly correlated with Mini-Mental State Examination scores (Spearman's rank correlation $r = -0.73$, $p < 0.001$)[9], and 'level I' corresponded with a 0.5 point rating on the Clinical Dementia Rating scale (specificity and sensitivity, 0.88)[10].

The certification committee also asked a panel of physicians to independently assess the applicants' cognitive disability levels to determine the applicants' care requirements[11]. The medical assessment was conducted independently of the in-home assessment[11]. In our analysis, we used the in-home assessment, but a previous study using some of the JAGES data found a high correlation between in-home assessment and the committee medical assessment (Pearson's correlation $r = 0.80$, $p < 0.001$)[12].

We defined cases more than IIa as dementia development, as validated by a previous study[13]. The standardized assessment manual for the cognitive disability in older people defines IIa as "individuals who had dementia-related symptoms, behavioural disturbance and/or difficulty in communication that limited daily living outside the home, but who were capable of daily living under someone's care"[8].

	Knee pain		Low back pain		No pain	Knee pain only	Low back pain only	Both knee and low back pain
	−	+	−	+				
Number	10785	3842	10375	4252	8964	1411	1821	2431
Age, year (SD)	72.8 (5.8)	74.9 (6.3)	73.0 (5.8)	74.1 (6.3)	72.8 (5.7)	74.6 (6.2)	72.8 (6.0)	75.1 (6.4)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Women	5339 (49.5)	2444 (63.6)	5371 (51.8)	2412 (56.7)	4447 (49.6)	924 (65.5)	892, (49.0)	1520 (62.5)
Obese	2130 (19.8)	1194 (31.1)	2181 (21.0)	1143 (26.9)	1742 (19.4)	439 (31.1)	388, (21.3)	755 (31.1)
Drinker	4083 (37.9)	1143 (29.8)	3800 (36.6)	1426 (33.5)	3392 (37.8)	408 (28.9)	691, (37.9)	735 (30.2)
Current smoker	1195 (11.1)	324 (8.4)	1096 (10.6)	423 (1.0)	988 (11.0)	108 (7.7)	207, (11.4)	216 (8.9)
History of diabetes mellitus	1331 (12.3)	540 (14.1)	1298 (12.5)	573 (13.5)	1112 (12.4)	186 (13.2)	219, (12.0)	354 (14.6)
History of hyper tension	4934 (45.8)	2082 (54.2)	4799 (46.3)	2217 (52.1)	4059 (45.3)	740 (52.5)	875, (48.1)	1089 (55.2)
Did not graduate from high school	4001 (37.1)	1881 (49.0)	3969 (38.3)	1913 (45.0)	3337 (37.2)	632 (44.8)	664, (36.5)	1249 (51.4)
Single	250 (2.3)	53 (1.4)	232 (2.2)	71 (1.7)	217 (2.4)	15 (1.1)	33, (1.8)	38 (1.6)
Low income	2725 (25.3)	1404 (36.5)	2681 (25.8)	1448 (34.1)	2235 (24.9)	446 (31.6)	490, (26.9)	958 (39.4)
Retired, n (%)	6428 (59.6)	2177 (56.7)	6152 (59.3)	2453 (57.7)	5320 (59.4)	832 (59.0)	1108 (60.9)	1345 (55.3)
Lost partner in last year	1224 (11.4)	659 (17.2)	1109 (10.7)	774 (18.2)	927 (10.3)	182 (12.9)	297, (16.3)	477 (19.6)
Lost relative, family, or friends in last year	3397 (31.5)	1331 (34.6)	3238 (31.2)	1490 (35.0)	2765 (30.9)	473 (33.5)	632, (34.7)	858 (35.3)
Frequency of going out <1/week	247 (2.3)	162 (4.3)	235 (2.3)	176 (4.1)	191 (2.1)	44 (3.1)	56, (3.1)	120 (4.9)
Never meets friends or acquaintances	695 (6.4)	335 (8.7)	686 (6.6)	344 (8.1)	577 (6.4)	109 (7.7)	118, (6.5)	226 (9.3)
Mood or anxiety disorder	353 (3.3)	312 (8.1)	339 (3.3)	326 (7.7)	263 (2.9)	76 (5.4)	90, (4.9)	236 (9.7)
Knee pain	—	—	1411 (13.6)	2431 (57.2)	—	—	—	—
Low back pain	1821 (16.9)	2431 (63.3)	—	—	—	—	—	—
Lack of regular walking	2243 (20.8)	1138 (29.6)	2129 (20.5)	1252 (29.4)	1770 (19.8)	359 (25.4)	473, (26.0)	779 (32.0)

Table 1. Mean values and proportions for participant characteristics. Abbreviations: SD: standard deviation. Note: Definition of obese: body mass index ≥25.

Definition of regular walking. We assessed average walking time per a day (<30, 30–59, 60–89, and ≥90 minutes), and we defined walking time per a day ≥30 minutes as regular walking.

Statistical analysis. We calculated person-months of follow-up from baseline to the first endpoint: dementia, death, moving away from the local government area where they were registered, loss to follow-up, or administrative censoring at February 21, 2017.

Multivariable adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) for dementia development according to existence of knee/low back pain were calculated using a Cox regression model. We also reran the main model after stratifying participants by age group or regular walking. As a sensitivity analysis, we reran the models after excluding participants suspected of mood or anxiety disorder (K6 ≥ 13 points) and those with both knee and low back pain.

P-values < 0.05 (two-tailed tests) were considered statistically significant. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Statement of ethics. All procedures were in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2013. All respondents were regarded as having provided their informed consent by returning the questionnaire. The Japan Gerontological Evaluation Study was approved by the Nihon Hukushi University Institutional Review Boards on human research (No. 13–14; date of approval: August 6, 2013). The title of the research was "The Japan Gerontological Evaluation Study (JAGES) project: the population-based large cohort."

Results

Table 1 shows the mean values and proportions for participant characteristics according to existence of knee pain or low back pain, and according to no pain, knee pain only, low back pain only, and both knee pain and low back pain during the past year. Compared with participants without knee pain or low back pain, those with knee pain or low back pain were more likely to be obese; to have high blood pressure, low income, and mood or anxiety disorder; to have lost a partner, relative, family, or friends in the last year; to go out less than once a week; and were less likely to be single, meet friends or acquaintances, and walk regularly.

In total, 482 (3.3%) developed dementia during follow-up. Table 2 shows the multivariable HRs for dementia development according to existence of knee or low back pain. Compared with participants without knee pain, those with knee pain had increased risk of dementia development [Model 6, HR 1.32 (95% CI: 1.06–1.64)].

In contrast, those with low back pain had decreased risk of dementia development compared with those without low back pain [Model 6, HR 0.79 (95% CI: 0.63–0.99)]. In model 1 and model 2 (the crude model and the sex-adjusted model), those with low back pain had an increased risk of dementia development. However, after adjusting for age, those with low back pain had a decreased risk of dementia development compared with those without low back pain. Therefore, we calculated HRs of dementia stratified by age group (Table 3). Both knee pain and low back pain increased the dementia risk among individuals aged ≤79 years, and decreased the dementia risk among individuals aged ≥80 years after adjusting for knee pain and low back pain.

	Knee pain		Low back pain	
	−	+	−	+
Total				
Person months	1008047.1	354044.7	96819.8	393922.0
Number of cases	298	184	322	160
Model 1 HR (95% CI)	1	1.77 (1.47–2.12)‡	1	1.22 (1.01–1.48)*
Model 2 HR (95% CI)	1	1.77 (1.47–2.13)‡	1	1.22 (1.01–1.47)*
Model 3 HR (95% CI)	1	1.21 (1.00–1.46)*	1	0.96 (0.79–1.16)
Model 4 HR (95% CI)	1	1.31 (1.06–1.62)*	1	0.85 (0.68–1.05)
Model 5 HR (95% CI)	1	1.39 (1.12–1.72)†	1	0.84 (0.68–1.05)
Model 6 HR (95% CI)	1	1.32 (1.06–1.64)*	1	0.79 (0.63–0.99)*

Table 2. Hazard ratios for dementia development according to knee pain and low back pain. Model 1: Crude model. Model 2: Adjusted for sex. Model 3: Adjusted for sex and age. Model 4: Adjusted for above-mentioned variables plus knee pain or low back pain. Model 5: Adjusted for above-mentioned variables plus body mass index, alcohol consumption, smoking, history of diabetes mellitus, and history of hyper tension. Model 6: Adjusted for above-mentioned variables plus education, marital status, equivalised income, employment status, loss events, frequency of going out, frequency of social interaction and mood or anxiety disorder. Abbreviations: HR: hazard ratio, CI: confidence interval. *$p < 0.05$, **$p < 0.01$.

		Knee pain			Low back pain	
	p for interaction	−	+	p for interaction	−	+
65–69 aged years						
Person months	—	345697.9	80076.4	—	315241.7	110532.7
Number of cases	—	30	4	—	29	5
Model 2 HR (95% CI)	—	1	N/A	—	1	N/A
Model 7 HR (95% CI)	—	1	N/A	—	1	N/A
70–74 aged years						
Person months	—	329330.5	105478.5	—	318097.8	116711.2
Number of cases	—	38	25	—	41	22
Model 2 HR (95% CI)	p = 0.01	1	2.09 (1.26–3.49)†	p = 0.02	1	1.47 (0.88–2.47)
Model 7 HR (95% CI)	p = 0.02	1	2.04 (1.14–3.64)*	p = 0.02	1	1.41 (0.93–2.15)
75–79 aged years						
Person months	—	199995.7	86935.5	—	199571.9	87359.30
Number of cases	—	53	39	—	57	35
Model 2 HR (95% CI)	—	1	1.72 (1.13–2.62)*	—	1	1.41 (0.92–2.15)
Model 7 HR (95% CI)	—	1	1.63 (1.01–2.64)*	—	1	1.11 (0.68–1.80)
80–84 aged years						
Person months	—	94293.8	55026.1	—	95807.3	53512.60
Number of cases	—	91	51	—	95	47
Model 2 HR (95% CI)	—	1	0.93 (0.66–1.32)	—	1	0.87 (0.62–1.24)
Model 7 HR (95% CI)	—	1	0.99 (0.67–1.47)	—	1	0.88 (0.59–1.30)
85–89 aged years						
Person months	—	31497.3	20941.6	—	32105.7	20333.30
Number of cases	—	59	44	—	72	31
Model 2 HR (95% CI)	—	1	1.11 (0.75–1.65)	—	1	0.67 (0.44–1.03)
Model 7 HR (95% CI)	—	1	1.45 (0.94–2.25)	—	1	0.56 (0.35–0.90)*
≥90 aged years						
Person months	—	7231.8	5586.7	—	7345.5	5473.00
Number of cases	—	27	21	—	28	20
Model 2 HR (95% CI)	—	1	1.15 (0.64–2.09)	—	1	1.03 (0.58–1.84)
Model 7 HR (95% CI)	—	1	1.18 (0.60–2.33)	—	1	0.95 (0.49–1.85)

Table 3. Hazard ratios of dementia stratified by age group. Model 2: Adjusted for sex. Model 7: Adjusted for sex and knee pain or low back pain. Abbreviations: HR: hazard ratio, CI: confidence interval. *$p < 0.05$, **$p < 0.01$.

Table 4 shows the multivariable HRs for dementia development according to no pain, knee pain only, low back pain only, and both knee pain and low back pain during the past year stratified by age group; 65–79 and ≥80 years old. Participants with knee pain only aged 65–79 years had an increased risk of dementia development [Model 9,

	No pain	Knee pain only	Low back pain only	Both knee and low back pain
Total				
Person months	837564.4	130605.4	170482.7	223439.3
Number of case	258	64	40	120
Model 1 HR (95% CI)	1	1.60 (1.21–2.10)‡	0.76 (0.55–1.06)	1.75 (1.41–2.17)‡
Model 2 HR (95% CI)	1	1.60 (1.21–2.11)‡	0.76 (0.55–1.06)	1.75 (1.41–2.17)‡
Model 3 HR (95% CI)	1	1.16 (0.88–1.53)	0.71 (0.51–0.99)*	1.14 (0.91–1.42)
Model 8 HR (95% CI)	1	1.25 (0.95–1.65)	0.72 (0.52–1.02)	1.20 (0.96–1.50)
Model 9 HR (95% CI)	1	1.20 (0.91–1.59)	0.69 (0.50–0.97)*	1.07 (0.84–1.34)
65–79 aged years				
Person months	729847.4	103063.9	14516.7	169426.4
Number of case	100	27	21	41
Model 9 HR (95% CI)	1	1.73 (1.11–2.68)*	1.04 (0.65–1.67)	1.39 (0.94–2.05)
≥80 aged years				
Person months	107717	27541.5	25306	54012.8
Number of case	200	52	30	103
Model 9 HR (95% CI)	1	0.94 (0.65–1.35)	0.50 (0.31–0.80)†	0.91 (0.68–1.22)

Table 4. Hazard ratios of dementia development according to no pain, knee pain only, low back pain only, and both knee pain and low back pain during the past year stratified by age group. Model 1: Crude. Model 2: Adjusted for sex. Model 3: Adjusted for sex and age. Model 8: Adjusted for above-mentioned variables plus body mass index, alcohol consumption, smoking, history of diabetes mellitus, and history of hyper tension. Model 9: Adjusted for above-mentioned variables plus education, marital status, equivalised income, employment status, loss events, frequency of going out, frequency of social interaction, and mood or anxiety disorder. Abbreviations: HR, hazard ratio; CI, confidence interval. *$p < 0.05$, ‡$p < 0.001$.

HR 1.73 (95% CI: 1.11–2.68)]. Those with low back pain aged ≥80 years had a decreased risk of dementia development [Model 9, HR 0.50 (95% CI: 0.31–0.80)].

Table 5 shows the multivariable HRs for dementia development stratified by regular walking. The associations of knee pain and low back pain with dementia risk were similar to the main results, regardless of regular walking. Individuals aged 65–79 years and ≥80 years who did not walk regularly and had knee pain had the highest dementia risk of the four groups (with/without knee pain; regular walking/no regular walking) [Model 6, HR: 1.91 (95% CI: 1.16–3.16), and HR: 1.63 (95% CI: 1.10–2.43), respectively]. Participants who experienced low back pain and did not walk regularly did not have an increased risk of dementia development compared with those with no low back pain who walked regularly.

The sensitivity analysis showed similar results to the main results (data not shown).

Discussion

In this sample of the Japanese general population, knee pain was prospectively associated with increased risk of dementia development particularly in individuals aged 65–79 years. The increased dementia risk in these individuals may be enhanced if they do not walk regularly. Low back pain was associated with reduced risk of dementia development among individuals ≥80 aged years, independent of physical activity, socioeconomic and psychosocial factors.

Knee pain among older people, which is usually caused by OA, is associated with inflammation[14,15]. Persistent inflammation damages cerebral blood vessels and induces neuroinflammation[14,15]. Research shows that both vascular dementia and Alzheimer's dementia are caused by inflammation[14,15]. Individuals with knee pain are likely to have a high sedative load, which can increase dementia risk. However, we suggest that knee pain (possibly accompanied by inflammation) itself, as well as physical inactivity, might increase dementia risk. Inflammation also contributes to some subtypes of low back pain, but the prevalence of inflammatory low back pain in one population-based study was only 5–6%[16].

A previous cohort study in Taiwan reported an association between OA and dementia development[4]. However, this previous observational study had several limitations. First, it used data from a health insurance database based on physicians' diagnoses in medical settings, and included only patients visiting hospitals or clinics; thus, the study did not consider individuals who had knee pain but did not consult a doctor. Second, this previous study did not account for socioeconomic and psychosocial factors in addition to physical activity; all of these are important risk factors for dementia. The present study did not have these limitations.

Approximately 85% of low back pain is a non-specific type of pain related to central nerve system[17]. A systematic literature review reported that OA pain including knee pain was also associated with central nerve system[18]. For a person to perceive a centralized pain, it is necessary for the prefrontal brain area to pay "sustained attention" to the pain[19], and sustained attention requires maintaining a certain level of brain function. For example, patients with cognitive disorder owing to dementia or Parkinson's disease often have decreased sustained attention[20,21]. Participants with low back pain aged ≥80 years had a decreased risk of dementia compared with those without low back pain. These findings may suggest that experiencing low back pain may be a marker of relatively maintained brain function among old-old people. We found that participants aged 65–79 years with knee pain only

			Knee pain			Low back pain	
		p for interaction	−	+	p for interaction	−	+
Regular walking	Person months of total		800788.7	250171.0		771816.7	279142.9
	Number of case		192	106		211	87
	Model 6 HR (95% CI)	0.52	1	1.38 (1.06–1.80)*	0.51	1	0.81 (0.62–1.07)
Lack of regular walking	Person months of total		207258.4	103873.7		196353.1	114779.1
	Number of case		106	78		111	73
	Model 6 HR (95% CI)	—	1.40 (1.10–1.80)†	1.71 (1.26–2.33)‡	—	1.40 (1.10–1.78)†	1.00 (0.74–1.34)
65–79 aged years							
Regular walking	Person months of total		704269.7	196443.2		672304.2	228408.8
	Number of case		85	41		89	37
	Model 6 HR (95% CI)	0.78	1	1.60 (1.06–2.43)*	0.60	1	0.96 (0.63–1.47)
Lack of regular walking	Person months of total		170754.3	76047.3		160607.2	86194.4
	Number of case		36	27		38	25
	Model 6 HR (95% CI)	—	1.31 (0.87–1.96)	1.91 (1.16–3.16)*	—	1.34 (0.91–1.99)	1.09 (0.66–1.79)
≥80 aged years							
Regular walking	Person months of total		96518.9	53727.8		99512.6	50734.2
	Number of case		107	65		122	50
	Model 6 HR (95% CI)	0.71	1	1.25 (0.88–1.75)	0.80	1	0.72 (0.50–1.04)
Lack of regular walking	Person months of total		36504.1	27826.5		35745.9	28584.7
	Number of case		70	51		73	48
	Model 6 HR (95% CI)	—	1.44 (1.05–1.98)*	1.63 (1.10–2.43)*	—	1.42 (1.04–1.94)*	0.96 (0.66–1.40)

Table 5. Hazard ratios of dementia stratified by regular walking. Model 6: Adjusted for age, sex, body mass index, knee pain or low back pain, alcohol consumption, smoking, history of diabetes mellitus, history of hyper tension, education, marital status, equivalised income, employment status, loss events, frequency of going out, frequency of social interaction, and mood or anxiety disorder. Abbreviations: HR, hazard ratio; CI, confidence interval. *$p < 0.05$, †$p < 0.01$, ‡$p < 0.001$.

had an increased risk of dementia, but those aged ≥80 years did not. Although inflammation related to knee pain may increase dementia risk, experiencing knee pain may be associated with maintained brain function particularly for old-old people; thus, old-old people (unlike other generations) may not have an increased risk of dementia.

One of the strengths of the present study is that we used a community-based prospective large cohort study design. However, the study has several limitations. First, data on the development of dementia were obtained from the results of an examination and assessment for a national Long-Term Care scheme. Residents aged ≥40 years with specific diseases and all residents aged ≥65 years can apply for the long-term care program if they wish; participants with dementia development who did not apply for the national long-term care program were not identified. Therefore, the number of individuals with dementia development might have been underestimated. Second, we were unable to differentiate dementia type (e.g., vascular or Alzheimer's dementia). Analysis of pathological information may have elucidated the mechanisms underlying the associations found here. Third, we did not measure pain intensity and therefore could not examine dose–response relationships between low back and knee pain and dementia risk. Fourth, we did not collect information about medical treatments. Treatment for pain, dementia, and other comorbidities may affect dementia development; however, we could not examine this potential confounding effect.

In conclusion, knee pain may increase dementia risk among Japanese older people aged 65–79 years, and this increased dementia risk may be enhanced if they do not walk regularly, independent of socioeconimic and psychosocial factors. Experience of low back pain may be a marker of maintained cognitive function despite age in old-old people aged ≥80 years, independent of physical activity, socioeconomic and psychosocial factors.

Data Availability

All enquiries should be addressed to the data management committee via e-mail: dataadmin.ml@jages.net. All JAGES datasets have ethical or legal restrictions for public deposition owing to inclusion of sensitive information from the human participants. Following the regulation of the local governments that cooperated with our survey, the JAGES data management committee has imposed restrictions upon the data.

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Acknowledgements

The authors thank Dr. Masahiko Shibata, Dr. Daita Kaneda, and Dr. Kenta Wakaizumi for their professional advice. We thank Diane Williams, PhD, from Edanz Group (www.edanzediting.com/ac) for editing a draft of this manuscript. This study used data from the Japan Gerontological Evaluation Study (JAGES), which was supported by MEXT (Ministry of Education, Culture, Sports, Science and Technology-Japan)-Supported Program for the Strategic Research Foundation at Private Universities (2009-2013), the JSPS (Japan Society for the Promotion of Science) KAKENHI Grant Numbers (JP15H01972, JP18390200, JP22330172, JP22390400, JP23243070, JP23590786, JP23790710, JP24390469, JP24530698, JP24683018, JP25253052, JP25870573, JP25870881,JP26285138, JP26882010), Health Labour Sciences Research Grants (H22-Choju-Shitei-008, H24-Junkanki [Seishu]-Ippan-007, H24-Chikyukibo-Ippan-009, H24-Choju-Wakate-009, H25-Kenki-Wakate-015, H25-Choju-Ippan-003, H26-Irryo-Shitei-003 [Fukkou], H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001, H28-Choju-Ippan-002, H28-Ninchisyou-Ippan-002, H30-Kenki-Ippan-006, H30-Junkankitou-Ippan-004), Japan Agency for Medical Research and Development (AMED) (JP17dk0110017, JP18dk0110027, JP18ls0110002, JP18le0110009, JP19dk0110034), and the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29–42, 30-22)). This research was also supported in part by a fellowship to Keiko Yamada from the Astellas Foundation for Research on Metabolic Disorders. The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Author Contributions

Design and conceptualized study, analyzed the data and drafted the manuscript for intellectual content (K.Y.); and interpreted the data, revised the manuscript for intellectual content (Y.K., T.T., K.S., H.I., N.K. and K.K.).

Additional Information

Competing Interests: The authors declare no competing interests.

Publisher's note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Journal of
Environmental Research and Public Health

MDPI

Article

Neighborhood Walkability in Relation to Knee and Low Back Pain in Older People: A Multilevel Cross-Sectional Study from the JAGES

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Received: 16 October 2019; Accepted: 15 November 2019; Published: 20 November 2019

Abstract: Few studies have focused on a relationship between the built environment and musculoskeletal pain. This study aimed to investigate an association between neighborhood walkability and knee and low back pain in older people. Data were derived from the Japan Gerontological Evaluation Study (JAGES) 2013, a population-based study of independently living people ≥65 years old. A cross-sectional multilevel analysis was performed, of 22,892 participants in 792 neighborhoods. Neighborhood walkability was assessed by residents' perceptions and population density. Dependent variables were knee and low back pain restricting daily activities within the past year. The prevalence of knee pain was 26.2% and of low back pain 29.3%. After adjusting for sociodemographic covariates, the prevalence ratio (PR) of knee and low back pain was significantly lower in neighborhoods with better access to parks and sidewalks, good access to fresh food stores, and higher population densities. After additionally adjusting for population density, easier walking in neighborhoods without slopes or stairs was significantly inversely correlated with knee pain (PR 0.91, 95% confidence interval 0.85–0.99). Neighborhoods with walkability enhanced by good access to parks and sidewalks and fresh food stores, easy walking without slopes or stairs, and high population densities, had lower prevalences of knee and low back pain among older people. Further studies should examine environmental determinants of pain.

Keywords: neighborhood walkability; built environment; musculoskeletal pain; knee pain; low back pain; older people; multilevel analysis

1. Introduction

Musculoskeletal diseases, including osteoarthritis (OA), are major public health problems. Between one in three and one in five people live with painful musculoskeletal conditions, making these diseases the second highest contributor to global disability. Low back pain alone is the leading cause of disability worldwide [1]. A strong relationship exists between musculoskeletal pain and a reduced capacity to engage in physical activity. This often results in functional decline, frailty, reduced quality of life, and loss of independence [2]. The prevalence and impact of musculoskeletal diseases are particularly high in older people. While OA may be treated surgically when severe, it is now considered amenable

to prevention and treatment in the early stages [3]. For example, weight loss for obesity, prevention of injury, and exercise have all been shown to be effective in reducing knee and lower back pains [4,5] Although strong evidence supports the benefits of regular exercise, physical inactivity remains highly prevalent worldwide [6]. In fact, the number of daily steps people take in Japan is decreasing year by year, despite the fact that walking, the most frequent type of exercise, is recommended by national health policy [7,8]. For many, however, it is difficult to get regular exercise, and there are limitations to the effects of policy pronouncements at the individual level where a number of other factors are in play.

One of these factors, the built environment, has been found to exert a noticeable influence on health [9–11]. The World Health Organization recommends improving the built environment as a way to promote healthy aging [12]. The built environment is related to physical activity [13,14], most notably in terms of neighborhood walkability [15,16]. Neighborhood walkability is a measure of how friendly the residential built environment is to walk in. It is generally expressed as a composite index of population density, land-use diversity, and pedestrian-friendly design [17]. Neighborhood walkability has been shown to be related to time spent walking [18], physical activity [15], obesity [19], and depression [20]. These are all factors which are also well known to be associated, in one way or another, with musculoskeletal pain.

However, few studies have investigated an association between the built environment and musculoskeletal pain. If neighborhood walkability is associated in some way with musculoskeletal pain, it would become clear that not only individual factors but environmental factors can be addressed in policies designed to prevent musculoskeletal pain. Therefore, we aimed to examine whether neighborhood walkability is related to knee and low back pain, focusing on older people in Japan.

2. Methods

2.1. Study Design and Participants

The present study is based on the Japan Gerontological Evaluation Study (JAGES), an ongoing population-based cohort study in Japan [21]. In 2013, self-reported questionnaires were mailed to 193,694 community-dwelling, independently-living individuals aged 65 years or older, of whom 137,736 responded to the survey (response rate, 71.1%). Participants with missing values for ID, age, or sex (n = 7996); who needed assistance in activities of daily living (n = 4247); or people living in communities with less than 30 respondents (n = 2108) were excluded from the analysis. A total of 123,385 participants' responses from 792 communities were used to evaluate neighborhood walkability. About one-fifth of the total participants (n = 24,806) was randomly selected, including some from each of the 792 communities, to complete a survey module enquiring about pain. The module was a planned part of the JAGES. Because long-term exposure to neighborhood walkability was considered to be beneficial, we excluded residents who had lived in their neighborhood for 3 years or less (n = 732). Responses were also excluded if data on knee and low back pain was missing (n = 1182). This left responses from 22,892 participants that were included in the subsequent analysis (Figure 1). Our research protocol and informed consent method were approved by the Ethics Committee of Nihon Fukushi University (number 13–14).

2.2. Outcome Variables

Data on the presence of knee and low back pain within the last year were collected in the survey by asking the following two questions. "In the past year, have you had knee pain that restricts your daily activities? In the past year, have you had low back pain that restricts your daily activities?" A response of "yes" was defined as the presence of pain.

2.3. Neighborhood Walkability

Many studies have established the predictive value of residents' perceptions as a measure of neighborhood walkability [22,23]. Previously studied relationships include those between access to

parks and body mass index (BMI) [24], food environment and mortality rate [25], and walking up slopes and diabetes control [26]. While some studies demonstrate that objective measures affect various health outcomes [19], two studies reported that subjective walkability rather than objective geographic information system-based data was associated with health outcomes [25,27]. Subjective walkability has the advantage of easily grasping the actual situation; for example, it can change depending on factors such as the size, number, and design during the evaluation of parks and sidewalks. Moreover, there are few studies on walkability in Japan, and the validity of objective indicators has not been sufficiently verified. Therefore, we used subjectively assessed walkability as an explanatory variable.

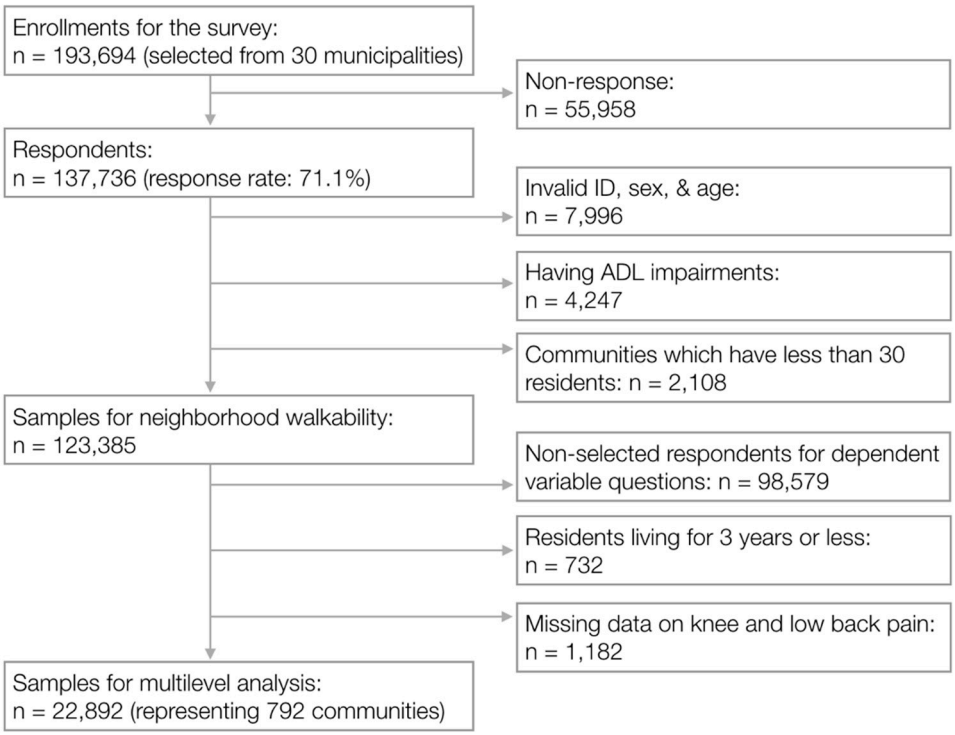

Figure 1. Flow of participant selection for the study of neighborhood walkability and musculoskeletal pain (n = 22,892). ID, identification; ADL, activities of daily living.

We evaluated neighborhood walkability by asking about access to parks and sidewalks, access to fresh food stores, and easy walking without slopes or stairs. Three questions were posed about the neighborhood within 1 km of the participant's house. "How do you feel about access to parks and sidewalks when walking? How many stores or facilities selling fresh fruit and vegetables are located near you? How do you feel about easy walking without slopes or stairs?" Responses were given on a four-point Likert scale, with 1 = none, 2 = a few, 3 = some, and 4 = many. The average of the points in each neighborhood was used to compare each walkability variable, resulting in a minimum of 1 and a maximum of 4 continuous points. To assess neighborhood walkability, we used the data derived from all 123,385 participants rather than only the smaller subset (n = 22,892) of individuals who responded to the questions about knee and low back pain.

We also used population density as a variable because it is one of the main factors associated with neighborhood walkability, as it includes factors such as land-use mix, access to public transport, and number of walkable destinations [17,28]. The population density of each of the 792 communities included for analysis was calculated using the 2010 census and Land Utilization Tertiary Mesh Data (as of 2010) of the National Land Numerical Information from the Ministry of Land, Infrastructure, Transport, and Tourism in Japan based on the 1:25,000 Topographic Map of Japan [29]. These calculations excluded undeveloped areas (e.g., rivers, lakes, forest, and wasteland). Quartiles of population density (persons/km^2) were used for analysis.

2.4. Covariates

For individual covariates, sociodemographic data, behavior, and health status were used. Sociodemographic covariates included sex, age (65–69, 70–74, 75–79, 80–84, and ≥85 years old), educational background (<10, 10–12, and ≥13 years), equivalent annual income (<2, 2–3.9, and ≥4 million yen per year), and past occupation (white-collar workers, blue-collar workers, primary industry workers, or never worked before) [30,31]. Primary industry workers in agriculture, forestry, and fisheries were considered separately from other blue-collar workers because those three occupations are known to be strongly associated with musculoskeletal pain [32]. Behaviors and health status covariates assessed included time spent walking (<30, 30–59, and ≥60 min a day), frequency of physical activity (<2, 2–3, and ≥4 times a week), driving status (driving a car by themselves or not) [33], BMI (<18.5, 18.5–24.9, and ≥25 kg/m^2), and depression (none, mild, severe) [34]. Physical activity referred to medium intensity exercise, such as walking quickly, dancing, and golf [35]. Participants were classified in three groups based on scores from the Japanese version of the Geriatric Depression Scale-15 [36,37]: not depressed (<5), mildly depressed (5–9), or severely depressed (≥10) [38,39]. Missing data was counted and listed as missing.

2.5. Statistical Analysis

We first calculated the association between each neighborhood walkability factor and knee or low back pain using Pearson's correlation coefficient. Multilevel Poisson regression models were then analyzed to investigate the association between neighborhood walkability and pain. An initial model was specified to assess the crude association between neighborhood walkability and knee or low back pain. This was then adjusted in Model 1 using sex, age, equivalent annual income, educational background, and past occupation as individual confounders to evaluate the influence of sociodemographic factors. Model 2 was additionally adjusted for walking time, physical activity, driving status, BMI, and depressive symptoms as potential confounders. As population density strongly affects various aspects and is easy to correlate with other walkability [28,40]. For example, in order to clarify that it is not just the influence of population density, we additionally adjusted the population density in Model 3. Using Appendix A, we identified whether covariates affected the outcomes. Stata 14.0 (StataCorp LP, College Station, TX, USA) was used, and prevalence ratios (PR) and 95% confidence intervals (CI) were calculated from the regression models. The significance level was set at 0.05. Participants with missing covariate data were still included in the analysis.

3. Results

The prevalence of knee pain and low back pain was 26.2% (n = 6257) and 29.3% (n = 6989), respectively (Table 1). The largest proportion by age was 70 to 74 years old (30.3%), followed by those 65 to 69 years old (28.0%). Approximately two-thirds of the participants had normal BMIs and no depression. More than a third (38.7%) walked >60 min; another third (35.2%) walked 30 to 59 min; and 23.9% walked <30 min. About half drove a car.

The means for the three subjective neighborhood walkability factors ranged from 2.56 to 2.97 (Table 2). The mean population density was 6543 persons/km^2 (22–31,565 persons/km^2). Reports by neighborhood of knee pain ranged from 15.6% to 51.4%, and of low back pain, from 13.6% to 51.4%. The Pearson correlations between neighborhood walkability factors were all significant. The correlations were relatively high between access to parks and sidewalks and access to fresh food stores; access to parks and sidewalks and population density; and access to fresh food stores and population density (0.44 to 0.59). There were significant negative correlations between knee pain and access to parks and sidewalks (−0.21); knee pain and population density (−0.33); and low back pain and population density (−0.17).

Table 1. Characteristics of older Japanese adults surveyed in JAGES 2013 with regard to neighborhood walkability (n = 22,892).

Characteristics	*n*	%
Sex		
Male	11,114	46.5
Female	12,775	53.5
Age, years		
65–69	6690	28
70–74	7231	30.3
75–79	5330	22.3
80–84	3147	13.2
85+	1491	6.2
Educational background, years		
13+	4713	19.7
10–12	8819	36.9
<10	9974	41.8
Missing	383	1.6
Equivalent annual income, yen		
4.0+ million	2025	8.5
2.0–3.9 million	7140	29.9
<2.0 million	9875	41.3
Missing	4849	20.3
Past occupation		
White-collar worker	8481	37.1
Blue-collar worker	9494	41.5
Primary industry worker	1291	5.6
Never worked	1170	5.1
Missing	2456	10.7
Walking time, min		
60+	9241	38.7
30–59	8401	35.2
<30	5704	23.9
Missing	543	2.3
Physical activity		
Daily	6858	28.7
Weekly	6517	27.3
Annually	3379	14.1
None	4999	20.9
Missing	2136	8.9
Driving status		
No	10,854	45.6
Yes	12,967	54.4
Body mass index, kg/m^2		
18.5–24.9	16,006	67
<18.5	1665	7
25+	6153	25.8
Missing	65	0.3
Depression		
None (GDS < 5)	14,223	62.1
Mild (GDS of 5–9)	3603	15.7
Severe (GDS ≥ 10)	1143	5
Missing	3923	17.1
Knee pain		
Yes	6314	26.2
Missing	646	2.8
Low back pain		
Yes	7050	29.3
Missing	657	2.9

GDS = Geriatric Depression Scale; JAGES = Japan Gerontological Evaluation Study.

Table 2. Pearson correlations between neighborhood walkability factors and pain.

	Mean	SD	Median	Minimum	Maximum	R					
						I	II	III	IV	V	VI
(i) Access to parks and sidewalks (score)	2.94	0.29	2.96	1.94	3.81	1					
(ii) Access to fresh food stores (score)	2.97	0.39	3.05	1.65	3.85	0.52 *	1				
(iii) Easy walking without slopes or stairs (score)	2.56	0.38	2.61	1.44	3.29	−0.17 *	0.08 *	1			
(iv) Population density (persons/km^2)	6543	4727	6719	22	31,565	0.44 *	0.59 *	0.24 *	1		
(v) Knee pain (%)	29	6.8	27.7	15.6	51.4	−0.21 *	−0.14	0.02	−0.33 *	1	
(vi) Low back pain (%)	32.9	6.9	32	13.6	51.4	−0.14	−0.14	−0.03	−0.17 *	0.63 *	1

For neighborhood factors (i to iv), n = 792, while for pain (v to vi), n = 148, calculated only for areas with more than 30 responses about pain. For factors i–iii, the average points on a scale from 1 to 4 (1 = none, 2 = few, 3 = some, 4 = many) were calculated for each community and then combined for analysis of each factor. * $p < 0.05$. SD = standard deviation.

In the Crude regression model, knee pain was significantly less prevalent with access to parks and sidewalks, access to fresh food stores, and a high population density (Table 3). After adjustment for sociodemographic confounders (Model 1) and behavior and activity covariates (Model 2), all three walkability factors remained statistically significant. After adjusting for population density in Model 3, the only statistically significant factor associated with less knee pain was ease of walking without slopes or stairs (PR = 0.91, 95% CI = 0.85–0.99).

Table 3. Association between neighborhood walkability and knee pain by multilevel Poisson regression analysis (n = 22,892).

	Crude Model	Model 1 [a]	Model 2 [b]	Model 3 [c]
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Access to parks and sidewalks	0.69 (0.63–0.76) *	0.84 (0.76–0.93) *	0.85 (0.77–0.94) *	0.92 (0.81–1.03)
Access to fresh food stores	0.81 (0.76–0.87) *	0.90 (0.84–0.96) *	0.90 (0.84–0.96) *	0.95 (0.87–1.03)
Easy walking without slopes or stairs	1.02 (0.94–1.10)	0.96 (0.89–1.04)	0.95 (0.88–1.02)	0.91 (0.85–0.99) *
Population density	0.91 (0.89–0.93) *	0.96 (0.94–0.98) *	0.95 (0.93–0.98) *	-

PR = prevalence ratio; 95% CI = 95% confidence interval. [a] Model 1 was adjusted for sex, age, equivalent annual income, educational background, and past occupation. [b] Model 2 was adjusted for the covariates in Model 1 plus walking time, physical activity, driving status, BMI, and depressive symptoms. [c] Model 3 was adjusted for the covariates in Model 2 plus population density. * $p < 0.05$.

For low back pain, the initial results were similar to those with knee pain (Table 4). However, with Models 1 and 2, only access to fresh food stores and population density remained significantly associated with less low back pain. After adjusting for population density, ease walking without slopes or stairs fell just short being statistically significant.

Table 4. Association between neighborhood walkability and low back pain by multilevel Poisson regression analysis (n = 22,892).

	Crude Model	Model 1 [a]	Model 2 [b]	Model 3 [c]
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Access to parks and sidewalks	0.81 (0.74–0.89) *	0.94 (0.85–1.03)	0.96 (0.88–1.06)	1.08 (0.97–1.20)
Access to fresh food stores	0.85 (0.80–0.90) *	0.92 (0.86–0.98) *	0.92 (0.86–0.98) *	0.98 (0.91–1.06)
Easy walking without slopes or stairs	1.02 (0.95–1.09)	0.98 (0.91–1.05)	0.96 (0.89–1.03)	0.93 (0.87–1.00)
Population density	0.92 (0.91–0.94) *	0.96 (0.94–0.98) *	0.96 (0.94–0.98) *	-

PR = prevalence ratio; 95% CI = 95% confidence interval. [a] Model 1 was adjusted for sex, age, equivalent annual income, educational background, and past occupation. [b] Model 2 was adjusted for the covariates in Model 1 plus walking time, physical activity, driving status, BMI, and depressive symptoms. [c] Model 3 was adjusted for the covariates in Model 2 plus population density. * $p < 0.05$.

4. Discussion

In a large and diverse, population-based sample, we found that subjectively perceived neighborhood walkability was associated with a lower prevalence of knee and low back pain. This relationship remained after adjusting for sociodemographic variables (Model 1). Although we adjusted for walking time, physical activity, driving status, BMI, and depressive symptoms as potential mediators, the association remained similar (Model 2). Even after adjusting for population density to eliminate that as a factor, one factor contributing to better walkability—ease of walking without slopes or stairs—was significantly negatively associated with knee pain (Model 3). To our knowledge, this is the first study indicating that features of the built environment may be correlated with the prevalence of musculoskeletal pain in a large-scale survey of older adults.

Earlier studies of neighborhood walkability indicated a negative association with obesity [19], which is a risk factor for knee and low back pain [3,41]. A population-based study of 9046 adults in Japan reported that living in a rural area was associated with a high prevalence of knee pain and low back pain [42]. However, that study did not adjust for occupation. The jobs of primary industry workers tend to place a heavy burden on the knee and low back, and many of these individuals live in rural areas. In our study, after adjusting for past occupation, we found that higher population density, access to parks and sidewalks and fresh food stores, and easy walking without slopes or stairs were related to lower prevalences of knee pain and low back pain.

The sociodemographic factors we assessed are considered key not only in regard to physical activity [43] and obesity [44] but to knee and low back pain, as we found relatively large changes in the PRs from the Crude Model to Model 1 after adjusting for sociodemographic factors. In fact, an association between low back pain and socioeconomic status, such as educational background, past occupations, and income, has been reported [31]. A longer time spent walking, greater physical activity, a lower BMI, and the absence of depression are factors known to be negatively related to knee and low back pain. Therefore, we initially hypothesized that these factors would be potential mediators, and as shown in the Appendix A, these factors were actually related to knee pain and low back pain. However, after adjusting for these covariates in Model 2, little change was seen in our results. Therefore, walking time, physical activity, BMI, and depression were thought to largely depend on sociodemographic status, and other factors should still be considered. Social environment variables such as social capital and safety may also be involved, as the social environment has been shown to be associated with cognitive function and social participation [45,46].

As a mechanism that might mediate the relationship between neighborhood walkability and pain, social interaction and the greenness provided by parks and sidewalks have been considered. Social interaction increases for people who frequently use parks [47] and can have a positive psychosocial influence. Good access to parks and sidewalks is likely to increase exposure to greenness which has also been shown to be associated with less obesity [48]. A fresh food store may be a place people would go every day, which would therefore encourage daily walking [25] as well as meeting friends. Such access to fresh food would also support a healthy diet that can be beneficial in preventing obesity. The relationship between walking up slopes or stairs and health is controversial [35,49]. However, to the extent that such features might hinder walking and physical activity among older adults, a flatter environment might be better in terms of walkability. Higher population density can lead to more walkable destinations, a better land-use mix, and better access to public transport and healthcare services [28]. We found that, compared with knee pain, low back pain was not significantly associated with access to parks and sidewalks or easy walking without slopes or stairs in Models 1–3. A previous review indicated that low back pain was strongly influenced by awkward posture among agricultural workers [50]. It may be, therefore, that knee pain is more closely linked with walking than is low back pain.

Strengths of this study include the focus on the association between the built environment and musculoskeletal pain in a large-scale population-based study. Past research has mainly focused on individual factors vis-à-vis musculoskeletal pain. However, it is difficult to get regular exercise and

maintain a desirable weight for people with and without pain. A population-based approach should also be used for investigating musculoskeletal pain, particularly when considering public policies to prevent disability or to improve the health system [21,51]. Our results will be useful in further research on environmental determinants of pain and specific population approaches such as the primordial prevention [52], which aims for a society where people live in a health-friendly place and remain healthy without additional effort because risk factors have been minimized.

Several limitations of this study should be mentioned. First, with the exception of population density, our explanatory variables were subjectively assessed. A comprehensive scale that takes into account various factors, such as walk score or MAPS Global tool, may also be useful [53,54]. In this study, we focused on subjective indicators because it was easy to comprehend the actual situation of each element; however, evaluation of both subjective and objective indicators in the future will lead to a more detailed verification of the relationship between the built environment and pain. Second, we selected certain items that seemed to be particularly influential among various factors contributing to walkability, and that have been reported to be useful in previous studies [24–26]. Other variables such as street connectivity and safety may warrant inclusion in similar studies [23,55]. This study did not include them because we thought the other factors were unlikely to be related to pain alone. Further research must explore which built environment elements and scales are associated with musculoskeletal pain. Third, our outcomes included both acute and chronic pain. However, knee pain in older people is mostly due to OA [56], and the relationship weakens when other causes of knee pain are included. Therefore, it can be said that the connection to neighborhood walkability is strong. Fourth, as this is a cross-sectional study, it cannot prove a causal relationship. Exercise has been shown to have a preventive and therapeutic effect on low back pain [4,57], so better neighborhood walkability could theoretically be beneficial by improving access to exercise. People without knee pain or low back pain might choose to live in areas with good walkability, but we could not evaluate that in our study because we excluded those who have lived in the same neighborhood for 3 years or less. Longitudinal studies will be needed to better examine the nature of the relationship between neighborhood walkability and the incidence of musculoskeletal pain. Finally, although there is a high generalizability in Japan, it is difficult to generalize these results to other countries with greatly differing environments and cultures, such as those in Europe and America. In the future, aiming at the realization of a society where pain is naturally prevented, research should be conducted on whether improvement of the built environment helps reduce the prevalence of musculoskeletal pain in various regions.

5. Conclusions

Good neighborhood walkability with access to parks and sidewalks and fresh food stores, easy walking without slopes or stairs, and high population density were associated with a lower prevalence of knee and low back pain among older people, as demonstrated in this large-scale, population-based, multilevel analysis. Further studies should examine not only individual factors but also environmental determinants of pain.

Author Contributions: Conceptualization, D.O. and K.K.; methodology, T.T., and M.H.; formal analysis, D.O. and Y.M.; validation, T.T., N.A. and K.K.; investigation, K.K.; writing—original draft preparation, D.O.; writing—review and editing, D.O., T.T., M.H., Y.M., N.A. and K.K.

Funding: This study used data from JAGES (the Japan Gerontological Evaluation Study), which was supported by MEXT (Ministry of Education, Culture, Sports, Science and Technology-Japan)-Supported Program for the Strategic Research Foundation at Private Universities (2009–2013); JST-OPERA program grant (JPMJOP1831); JSPS (Japan Society for the Promotion of Science) KAKENHI (grant numbers JP18390200, JP22330172, JP22390400, JP23243070, JP23590786, JP23790710, JP24390469, JP24530698, JP24683018, JP25253052, JP25870573, JP25870881, JP26285138, JP26882010, and JP15H01972); Health Labor Sciences Research Grants (grant numbers H22-Choju-Shitei-008, H24-Junkanki (Seishu)-Ippan-007, H24-Chikyukibo-Ippan-009, H24-Choju-Wakate-009, H25-Kenki-Wakate-015, H25-Choju-Ippan-003, H26-Irryo-Shitei-003 (Fukkou), H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001, H28-choju-Ippan-002, H30-Kenki-Ippan-006, and H30-Junkankitou-Ippan-004); Japan Agency for Medical Research and Development (AMED) (grant numbers 171s0110002, 18le0110009, and JP19dk0110034); the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (grant numbers 24-17, 24-23, and

29-42); and the World Health Organization Centre for Health Development (WHO Kobe Centre) (WHO APW 2017/713981). The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Acknowledgments: We are particularly grateful to the staff members in each study area, and in the central office, for conducting the survey.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Association between covariates and knee pain by multilevel Poisson regression analysis (n = 22,892).

		Access to Parks and Sidewalks	Access to Fresh Food Stores	Easy Walking without Slopes or Stairs	Population Density
		PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Sex	Male	ref	ref	ref	ref
	Female	1.51 (1.42–1.60)	1.51 (1.43–1.60)	1.51 (1.43–1.61)	1.50 (1.42–1.59)
Age, years	65–69	ref	ref	ref	ref
	70–74	1.21 (1.12–1.30)	1.20 (1.12–1.30)	1.20 (1.12–1.30)	1.21 (1.12–1.30)
	75–79	1.45 (1.34–1.56)	1.45 (1.34–1.56)	1.45 (1.34–1.56)	1.45 (1.35–1.57)
	80–84	1.68 (1.54–1.83)	1.68 (1.54–1.83)	1.68 (1.54–1.83)	1.68 (1.54–1.83)
	85+	1.74 (1.57–1.94)	1.75 (1.57–1.94)	1.75 (1.57–1.95)	1.74 (1.56–1.94)
Educational background, years	13+	ref	ref	ref	ref
	10–12	1.06 (0.98–1.15)	1.07 (0.98–1.15)	1.07 (0.99–1.16)	1.06 (0.98–1.15)
	<10	1.16 (1.07–1.25)	1.17 (1.08–1.26)	1.18 (1.09–1.28)	1.15 (1.06–1.25)
	Missing	1.17 (0.95–1.42)	1.17 (0.96–1.42)	1.19 (0.97–1.45)	1.15 (0.95–1.41)
Equivalent annual income, yen	4.0+ million	ref	ref	ref	ref
	2.0–3.9 million	1.22 (1.10–1.35)	1.22 (1.10–1.35)	1.22 (1.10–1.36)	1.21 (1.09–1.35)
	<2.0 million	1.02 (0.92–1.14)	1.03 (0.92–1.14)	1.03 (0.92–1.14)	1.02 (0.92–1.14)
	Missing	1.09 (0.97–1.22)	1.10 (0.98–1.23)	1.10 (0.98–1.23)	1.09 (0.97–1.22)
Past occupation	White-collar worker	ref	ref	ref	ref
	Blue-collar worker	1.08 (1.01–1.15)	1.08 (1.01–1.15)	1.08 (1.01–1.15)	1.07 (1.01–1.14)
	Primary industry worker	1.56 (1.41–1.73)	1.56 (1.45–1.72)	1.60 (1.45–1.77)	1.53 (1.37–1.69)
	Never worked	1.13 (1.01–1.26)	1.13 (1.01–1.26)	1.13 (1.01–1.26)	1.12 (1.01–1.25)
	Missing	1.16 (1.06–1.27)	1.16 (1.07–1.27)	1.16 (1.07–1.27)	1.15 (1.05–1.26)
Walking time, min	60+	ref	ref	ref	ref
	30–59	1.20 (1.13–1.29)	1.21 (1.13–1.29)	1.21 (1.13–1.29)	1.20 (1.13–1.29)
	<30	1.11 (1.05–1.18)	1.11 (1.05–1.18)	1.11 (1.04–1.18)	1.11 (1.05–1.19)
	Missing	1.10 (0.93–1.30)	1.10 (0.93–1.30)	1.11 (0.94–1.32)	1.09 (0.92–1.29)
Physical activity	Daily	ref	ref	ref	ref
	Weekly	1.06 (0.98–1.14)	1.06 (0.98–1.14)	1.05 (0.98–1.13)	1.06 (0.99–1.14)
	Annually	1.10 (1.00–1.20)	1.10 (1.00–1.20)	1.09 (1.00–1.19)	1.10 (1.01–1.20)
	None	1.22 (1.13–1.32)	1.22 (1.13–1.32)	1.21 (1.13–1.31)	1.23 (1.14–1.32)
	Missing	1.15 (1.04–1.27)	1.15 (1.04–1.27)	1.15 (1.04–1.26)	1.15 (1.04–1.27)
Driving status	No	ref	ref	ref	ref
	Yes	1.02 (0.94–1.08)	1.04 (0.96–1.08)	1.04 (0.98–1.10)	1.01 (0.95–1.07)
Body mass index, kg/m^2	18.5–24.9	ref	ref	ref	ref
	<18.5	0.77 (0.69–0.87)	0.78 (0.70–0.87)	0.78 (0.69–0.87)	0.77 (0.69–0.87)
	25+	1.38 (1.31–1.46)	1.38 (1.31–1.46)	1.39 (1.32–1.47)	1.38 (1.31–1.46)
	Missing	1.00 (0.60–1.67)	1.01 (0.61–1.67)	1.01 (0.61–1.68)	1.02 (0.62–1.70)
Depression	None (GDS < 5)	ref	ref	ref	ref
	Mild (GDS of 5–9)	1.52 (1.42–1.62)	1.52 (1.43–1.63)	1.52 (1.43–1.63)	1.52 (1.43–1.63)
	Severe (GDS ≥ 10)	1.79 (1.62–1.96)	1.79 (1.62–1.96)	1.79 (1.63–1.97)	1.78 (1.62–1.96)
	Missing	1.20 (1.12–1.29)	1.20 (1.12–1.29)	1.20 (1.12–1.29)	1.20 (1.12–1.29)

PR = prevalence ratio; 95% CI = 95% confidence interval.

Table A2. Association between covariates and low back pain by multilevel Poisson regression analysis (n = 22,892).

		Access to Parks and Sidewalks	Access to Fresh Food Stores	Easy Walking without Slopes or Stairs	Population Density
		PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Sex	Male	ref	ref	ref	ref
	Female	1.17 (1.11–1.23)	1.17 (1.11–1.23)	1.17 (1.11–1.23)	1.17 (1.11–1.23)
Age, years	65–69	ref	ref	ref	ref
	70–74	1.03 (0.96–1.10)	1.03 (0.97–1.11)	1.03 (0.96–1.10)	1.03 (0.97–1.10)
	75–79	1.18 (1.10–1.27)	1.18 (1.10–1.27)	1.18 (1.10–1.27)	1.18 (1.10–1.27)
	80–84	1.28 (1.18–1.39)	1.28 (1.18–1.39)	1.28 (1.18–1.39)	1.28 (1.18–1.39)
	85+	1.41 (1.28–1.56)	1.41 (1.27–1.56)	1.41 (1.28–1.56)	1.41 (1.27–1.55)
Educational background, years	13+	ref	ref	ref	ref
	10–12	1.02 (0.95–1.09)	1.02 (0.95–1.09)	1.02 (0.95–1.11)	1.02 (0.95–1.09)
	<10	1.07 0.99–1.15)	1.06 0.99–1.14)	1.07 1.00–1.15)	1.05 0.98–1.13)
	Missing	1.01 (0.82–1.24)	1.01 (0.82–1.23)	1.01 (0.83–1.25)	1.00 (0.81–1.22)
Equivalent annual income, yen	4.0+ million	ref	ref	ref	ref
	2.0–3.9 million	1.25 (1.13–1.37)	1.24 (1.13–1.37)	1.25 (1.13–1.38)	1.24 (1.13–1.37)
	<2.0 million	1.11 (1.01–1.23)	1.11 (1.01–1.23)	1.11 (1.01–1.23)	1.11 (1.00–1.23)
	Missing	1.14 (1.02–1.27)	1.14 (1.02–1.27)	1.14 (1.03–1.28)	1.14 (1.02–1.27)
Past occupation	White-collar worker	ref	ref	ref	ref
	Blue-collar worker	1.01 (0.96–1.08)	1.01 (0.96–1.07)	1.01 (0.96–1.08)	1.01 (0.95–1.07)
	Primary industry worker	1.46 (1.33–1.61)	1.44 (1.31–1.59)	1.46 (1.34–1.63)	1.41 (1.28–1.56)
	Never worked	1.09 (0.98–1.22)	1.09 (0.98–1.21)	1.09 (0.98–1.22)	1.09 (0.98–1.21)
	Missing	1.09 (1.00–1.19)	1.09 (0.99–1.18)	1.09 (1.00–1.19)	1.08 (0.99–1.18)
Walking time, min	60+	ref	ref	ref	ref
	30–59	1.28 (1.20–1.36)	1.28 (1.20–1.36)	1.28 (1.20–1.36)	1.28 (1.20–1.36)
	<30	1.11 (1.05–1.18)	1.11 (1.05–1.18)	1.11 (1.05–1.18)	1.11 (1.05–1.18)
	Missing	1.13 (0.95–1.33)	1.13 (0.95–1.32)	1.13 (0.96–1.34)	1.13 (0.95–1.32)
Physical activity	Daily	ref	ref	ref	ref
	Weekly	1.09 (1.02–1.17)	1.09 (1.02–1.17)	1.09 (1.02–1.17)	1.09 (1.02–1.17)
	Annually	1.06 (0.98–1.15)	1.06 (0.98–1.15)	1.06 (0.97–1.15)	1.06 (0.98–1.15)
	None	1.19 (1.11–1.28)	1.19 (1.11–1.28)	1.19 (1.11–1.27)	1.19 (1.11–1.28)
	Missing	1.20 (1.09–1.32)	1.20 (1.10–1.32)	1.20 (1.09–1.32)	1.21 (1.10–1.33)
Driving status	No	ref	ref	ref	ref
	Yes	1.08 (1.02–1.14)	1.08 (1.02–1.14)	1.09 (1.03–1.15)	1.08 (1.01–1.13)
Body mass index, kg/m^2	18.5–24.9	ref	ref	ref	ref
	<18.5	0.96 (0.87–1.05)	0.96 (0.87–1.05)	0.96 (0.87–1.05)	0.96 (0.87–1.05)
	25+	1.18 (1.12–1.25)	1.18 (1.12–1.25)	1.18 (1.12–1.25)	1.18 (1.12–1.25)
	Missing	1.12 (0.72–1.73)	1.12 (0.72–1.73)	1.12 (0.72–1.73)	1.14 (0.73–1.76)
Depression	None (GDS < 5)	ref	ref	ref	ref
	Mild (GDS of 5–9)	1.53 (1.44–1.63)	1.53 (1.44–1.63)	1.53 (1.44–1.63)	1.53 (1.44–1.63)
	Severe (GDS ≥ 10)	1.81 (1.65–1.98)	1.81 (1.65–1.98)	1.81 (1.65–1.98)	1.80 (1.64–1.97)
	Missing	1.31 (1.23–1.44)	1.31 (1.23–1.40)	1.31 (1.23–1.40)	1.31 (1.22–1.40)

PR = prevalence ratio; 95% CI = 95% confidence interval.

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Association between Food Store Availability and the Incidence of Functional Disability among Community-Dwelling Older Adults: Results from the Japanese Gerontological Evaluation Cohort Study

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Received: 9 July 2019; Accepted: 26 September 2019; Published: 4 October 2019

Abstract: This study sought to clarify the association between food store availability and the incidence of disability in older adults. This study utilized a population-based cohort study of independent Japanese adults aged ≥65 years, which was a 6 year follow-up of participants in the Japan Gerontological Evaluation Study. A total of 31,273 respondents were extracted. Food store availability was evaluated based on the existence of food stores within 500/1000 m of the home. We utilized participant-reported subjective measurement as well as geographic information system-based objective measurement for the evaluation. The incidence of disability was determined using municipal data on eligibility for long-term care insurance benefits. There were 7643 (24.4%) community-dwelling participants with low subjective food store availability and 5673 (18.1%) with low objective food store availability. During the follow-up period of 6 years, the cumulative incidence of disability was 20.9%, with a significant association between low subjective food store availability and increased disability. Participants who reported low subjective food store availability had a significantly higher likelihood of developing disability (hazard ratio = 1.18, 95% confidence interval: 1.11–1.25) than those who reported high subjective food store availability after adjusting for age, sex, sociodemographic status, environmental status, walking and going out, dietary food intake, body mass index, and comorbidities. Low subjective food store availability was associated with early onset of disability. Accessibility of food stores might contribute to maintaining a disability-free life.

Keywords: food environment; food stores; functional disability

1. Introduction

Life expectancy is increasing worldwide, with a resultant increase in the elderly population who are at high risk of physical frailty, sarcopenia, progressive functional disability, dependency, and institutionalization, and will have serious social, medical, and economic impacts [1]. Malnutrition is considered a major risk factor of frailty, sarcopenia, impairment, and disability [2]. The Asia-Pacific Clinical Practice Guidelines for the Management of Frailty provisionally recommend that screening should be performed for frail older adults who have unintended weight loss to identify possible reversible causes and that protein and caloric supplementation/food fortification should be considered in such individuals [3]. The clinical guidelines for sarcopenia state that appropriate nutritional intake could prevent the onset of sarcopenia and is therefore recommended [4].

Personal dietary habits, as well as accessibility to food in terms of whether a variety of foods can be obtained, are considered to affect nutritional status. Many older adults face obstacles to accessing food due to a decline in walking and movement ability. As humans, we eat every day, so the food environment can affect us all and has a great influence. People who reside far from a grocery store are reported to have a 25%–46% lower likelihood of healthy dietary habits than those with the most stores nearby among community-dwelling residents in the United States [5]; low subjective accessibility of food increases the risk of low dietary variability among community-dwelling older adults in Japan [6]. According to Sharkey et al., objective and subjective indices of accessibility to a food store, such as further distance to the nearest grocery store, food stores that stock a diverse array of fresh and processed fruit, or those with a wide assortment of fresh and processed vegetables, were associated with reduced regular intake of fruit and vegetables based on data from community residents in the United States [7]. Also, cohort data targeting community-dwelling older adults in Japan showed that living in a food environment located in a poor neighborhood can possibly lead to malnutrition [8], while improved access to food stores was associated with higher body mass index (BMI) [9].

Previous studies have shown that the food environment might impact incidence of mortality and dementia in older people [10,11]. If one's main reason for going out is to shop at a neighborhood grocery store, food store availability might influence the incidence of functional disability in many older adults. However, the relationship between food store availability and functional disability has not been sufficiently verified so far. This study sought to verify the association between food store availability and the incidence of functional disability among older community-dwellers.

2. Materials and Methods

2.1. Study Population

We used prospective cohort data of a large-scale population-based study that involved older Japanese people aged ≥65 years from the Japan Gerontological Evaluation Study (JAGES) [12].

Data from JAGES were collected from eight municipalities in four prefectures (Hokkaido, Yamanashi, Aichi, and Nagasaki). Baseline data were collected from August 2010 to January 2012. Self-administered questionnaires were sent by mail to independently living individuals in the relevant community. From 52,180 participants who had no certified need for long-term care insurance, we used data on 31,273 participants, after excluding participants with missing information on subjective and/or objective food store availability (20,907 participants). All the participants were duly notified that participation in the JAGES project was voluntary and that returning the completed questionnaire would be considered as consent to participate. Ethics approval (No. 13–14) was obtained from the Ethics Committee at our university.

2.2. Measurements and Variable Definitions

Subjective food store availability was evaluated based on a self-reported questionnaire. The questionnaire consisted of a single question on subjective food store availability: "How many food stores or facilities that sell fresh fruits and vegetables are within 1 kilometer of your house?", rated on

a 4-point scale ("none", "few", "some", "many") [6]. We defined "many" and "some" as high, and "few" and "none" as low subjective food store availability.

Objective food store availability was evaluated using geographic information system (GIS)-based methods [13]. Our study utilized 500 m mesh data from the Commercial Establishment Survey of the Ministry of Economy, Trade and Industry [14]. Food stores comprised department stores, general merchandise retailers, convenience stores, and specialty grocery stores. On the premise that all kinds of stores were uniformly distributed in the 500 m mesh, the number of stores along a straight line in a 500 m radius of the residence of each participant was then calculated according to the area of proportional distribution of the map area. All spatial calculations were performed with ArcGIS 10.1 software. Participants who had stores along a straight line within a radius of 500 m from the center of their residential community blocks were categorized as having high objective food store availability and those without stores within a radius of 500 m were categorized as having low objective food store availability. We defined 500 m or less as a reasonable "walkable" distance to a food store, which has been used in similar studies [15,16].

The primary outcome was functional disability, which we defined as certified need for care or support under the long-term care insurance system of Japan [17]. Follow-up of participants was carried out for 6 years based on their incident functional disability. Incident functional disability data was obtained from databases of public municipal long-term care insurance. Participants who had been recently certified as needing care or support through Japan's long-term care insurance system were deemed as having functional disability [18]. Eligibility for insurance certification is determined based on a national standardized procedure that includes a medical examination by a physician and assessment of physical status and cognitive function.

Demographic variables included age and sex in the baseline survey. Sociodemographic status, walking and going out, driving status, neighborly relationships, nutritional status, and comorbidities were evaluated with a self-reported questionnaire. Variables of social and demographic status were educational attainment, yearly income, living arrangements, employment status, and marital status. Yearly income was adjusted for household size, where income was divided by the square root of the number of individuals per household. Variables of walking as well as going out comprised daily walking time and frequency of going out. For nutritional status, variables were BMI and fruit/vegetable intake and meat/fish intake rate over the previous month. Standard BMI categories were then used to classify participants as obese, overweight, normal, or underweight [19]. Neighborly relationships were evaluated as described by Nakamura et al. [6] by asking about the kind of relationship they have with others in their neighborhood. The responses included the frequency of exchanging greetings or conversing with neighbors and borrowing/lending items, and based on the results, participants were classified as having either a high- or low-level relationship with their neighbors. Variables about comorbidities included therapy for medical conditions/symptoms and symptoms of depression. Multiple answers were permitted, and so participants were required to state whether or not they were at the time receiving medical treatment for malignancy, cardiac disease, stroke, high blood pressure, diabetes mellitus, arthropathy/neuralgia, traumatic fracture, pulmonary disease, and gastrointestinal disorder and dysphagia. Using the Geriatric Depression Scale-15 (Japanese version) [20], symptoms of depression in older adults were assessed and participants were classified into either a non-depressed or depressed group. Cognitive function was categorized as "decline" versus "no decline" and was evaluated with a self-reported questionnaire [21]. Also, we calculated the population density of habitable land in the residential school districts of each participant using the 2010 census results and data for land utilization tertiary mesh (2010) from the National Land Numerical Information of the Ministry of Land, Infrastructure, Transport and Tourism, based on a topographic map of Japan (1:25,000). All non-developed areas, such as rivers, lakes, forests, and wasteland, were excluded from the calculations. All covariates with missing data were classified as "missing." Categories for each variable are shown in Table 2.

2.3. Statistical Analysis

Baseline characteristics of the study participants were defined, and then multivariate cox regression analysis was applied to evaluate the association between food store availability and incident functional disability during the 6 years of follow-up. Four models were generated: Model 1: adjusted for age and sex; Model 2: further adjusted for sociodemographic status (educational attainment, marital status, and employment status, yearly income, and living conditions) as confounding factors to examine whether the relationship between food store availability and disability was independent of other aspects of environmental status; Model 3: additionally adjusted for environmental status (driving status, neighborly relationships, and population density) to investigate whether the relationship between food store availability and functional disability was independent of other environmental factors; and Model 4: further adjusted for walking and going out (daily walking time and rate of going out), dietary food intake (frequency of fruit/vegetable and meat/fish intake), BMI, and comorbidities (malignancy, heart disease, stroke, hypertension, diabetes mellitus, joint disease/neuralgia, traumatic fracture, respiratory disease, digestive disease, dysphagia, depression, and cognitive decline) as potential mediating factors linking food store availability to functional disability. Analyses were performed using SPSS Statistics 19 (IBM Corp., Armonk, NY, USA).

3. Results

Table 2 shows the baseline characteristics of the participants and the incidence of functional disability after the 6 year follow-up period. Among all participants (n = 31,273, mean age: 74.1 years), 20.5% worked, 84.2% lived with others, 70.1% were married, 7.6% were underweight, 32.5% had cognitive decline, 24.4% had low subjective food store availability, 18.1% had low objective food store availability, and cumulative incidence of functional disability after 6 years was 20.9%. Male, super-old (>80 years) and non-car users tended to have low subjective and objective food store availability. Participants with both low subjective and objective food store availability tended to have low rates of going out. The prevalence of comorbidities was similar between participants with low food store availability and those with high food store availability. Participants with low subjective and objective food store availability tended to have high functional disability.

Results of Cox regression analysis are shown in Table 3. Participants who reported low subjective food store availability had significantly higher likelihood of developing disability (hazard ratio = 1.20, 95% confidence interval: 1.13–1.27; $p < 0.001$) than those who reported high food store availability after age and sex adjustment (Model 1). These hazard ratios were unchanged and remained statistically significant following additional adjustments for sociodemographic and environmental status (Model 2,3). The hazard ratio was slightly reduced but remained statistically significant (hazard ratio = 1.18, 95% confidence interval: 1.11–1.25; $p < 0.001$) after further adjustment for potential mediating factors (walking and going out, nutritional status, and comorbidities) (Model 4). However, objective food store availability showed no significant association with disability after age and sex adjustment in Model 1 (hazard ratio = 0.98, 95% confidence interval: 0.92–1.05; $p = 0.61$). In addition, no significant difference in objective food store availability was evident between Model 2 (hazard ratio = 0.98, 95% confidence interval: 0.92–1.04; $p = 0.60$), Model 3 (hazard ratio = 1.00, 95% confidence interval: 0.93–1.06; $p = 0.82$) and Model 4 (hazard ratio = 1.00, 95% confidence interval: 0.94–1.08; $p = 0.84$).

Table 1. Baseline characteristics of participants and incidence of functional disability after 6 years.

		All Participants	Subjective Food Store Availability		Objective Food Store Availability	
		(*n* = 31,273)	Low (*n* = 7643)	High (*n* = 23,630)	Low (*n* = 5673)	High (*n* = 25,600)
Sex	Male	14,411 (46.1)	3227 (42.2)	11,184 (47.3)	2589 (45.6)	11,822 (46.2)
	Female	16,862 (53.9)	4416 (57.8)	12,446 (52.7)	3084 (54.4)	13,778 (53.8)
Age (years)	65–69	8255 (6.4)	2035 (26.6)	6220 (26.3)	1377 (24.3)	6878 (26.9)
	70–74	9644 (0.8)	2230 (29.2)	7414 (31.4)	1677 (29.6)	7967 (31.1)
	75–79	7390 (23.6)	1794 (23.5)	5596 (23.7)	1406 (24.8)	5984 (23.4)
	≥80	5984 (19.1)	1584 (20.7)	4400 (18.6)	1213 (21.4)	4771 (18.6)
Educational attainment (years)	<6	684 (2.2)	213 (2.8)	471 (2.0)	205 (3.6)	479 (1.9)
	6–9	13,719 (43.9)	3592 (47.0)	10,127 (42.9)	2912 (51.3)	10,807 (42.2)
	10–12	10,606 (33.9)	2447 (32.0)	8159 (34.5)	1622 (28.6)	8984 (35.1)
	≥13	5503 (17.6)	1160 (15.2)	4343 (18.4)	804 (14.2)	4699 (18.4)
	Others/missing	761 (2.4)	231 (3.0)	530 (2.3)	130 (2.3)	655 (2.5)
Employment status	Working	6420 (20.5)	1456 (19.1)	4964 (21.0)	1295 (22.8)	5125 (20.0)
	Retired	17,333 (55.4)	4057 (53.1)	13,276 (56.2)	2710 (47.8)	14,623 (57.1)
	Never worked	3532 (11.3)	1000 (13.1)	2532 (10.7)	708 (12.5)	2824 (11.0)
	missing	3988 (12.8)	1130 (14.8)	2858 (12.1)	960 (16.9)	3028 (11.8)
Yearly income (yen, millions)	<2.00	13,279 (42.5)	3378 (44.2)	9901 (41.9)	2643 (46.6)	10,636 (41.5)
	2.00–3.99	9645 (30.8)	2188 (28.6)	7457 (31.6)	1520 (26.8)	8125 (31.7)
	≥4.00	2732 (8.7)	584 (7.6)	2148 (9.1)	441 (7.8)	2291 (8.9)
	missing	5617 (18.0)	1493 (19.5)	4124 (17.5)	1069 (18.8)	4548 (17.8)
Living conditions	Live alone	4193 (13.4)	1143 (15.1)	3050 (13.0)	712 (12.6)	3481 (13.6)
	Live with others	26,330 (84.2)	6318 (83.2)	20,012 (85.5)	4833 (85.8)	21,497 (84.7)
	missing	487 (1.6)	130 (1.7)	357 (1.5)	90 (1.6)	397 (1.6)
Marital status	Married	21,908 (70.1)	5031 (65.8)	16,877 (71.4)	4006 (70.6)	17,902 (69.9)
	Widowed	6783 (21.7)	1926 (25.2)	4857 (20.6)	1209 (21.3)	5574 (21.8)
	Divorced	1197 (3.8)	314 (4.1)	883 (3.7)	184 (3.2)	1013 (4.0)
	Never married	713 (2.3)	195 (2.6)	518 (2.2)	123 (2.2)	590 (2.3)
	Other/missing	672 (2.1)	177 (2.3)	495 (2.1)	151 (2.6)	521 (2.0)
Driving status	Non-car users	7865 (25.1)	2392 (31.3)	5473 (23.2)	1772 (31.2)	6093 (23.8)
	Car users	10,328 (33.0)	2647 (34.6)	7681 (32.5)	2120 (37.4)	8208 (32.1)
	missing	13,080 (41.8)	2604 (34.1)	10,476 (44.3)	1781 (31.4)	11,299 (44.1)

Table 2. Baseline characteristics of participants and incidence of functional disability after 6 years.

		All Participants	Subjective Food Store Availability		Objective Food Store Availability	
		(*n* = 31,273)	Low (*n* = 7643)	High (*n* = 23,630)	Low (*n* = 5673)	High (*n* = 25,600)
Neighborly relationships	High level	21,653 (69.2)	5197 (68.0)	16,456 (69.6)	4224 (74.5)	17,429 (68.1)
	Low level	7532 (24.1)	1960 (25.6)	5572 (23.6)	1052 (18.5)	6480 (25.3)
	missing	2088 (6.7)	486 (6.4)	1602 (6.8)	397 (7.0)	1691 (6.6)
Frequency of going out	Everyday	16,031 (51.3)	3320 (43.4)	12,711 (53.8)	2352 (41.5)	13,679 (53.4)
	≥2 times/week	8750 (28.0)	2311 (30.2)	6439 (27.2)	1746 (30.8)	7004 (27.4)
	≤1 time/week	4759 (15.2)	1553 (20.3)	3206 (13.6)	1265 (22.3)	3494 (13.6)
	missing	1733 (5.5)	459 (6.0)	1274 (5.4)	310 (5.5)	1423 (5.6)
Daily walking time	≥1 h/day	9139 (29.2)	2127 (27.8)	7012 (29.7)	1731 (30.5)	7408 (28.9)
	<1 h/day	20,249 (64.7)	5007 (65.5)	15,242 (64.5)	3577 (63.1)	16,672 (65.1)
	Missing	1885 (6.0)	509 (6.7)	1376 (5.8)	365 (6.4)	1520 (5.9)
Frequency of meat/fish intake	≥1 time/day	12,126 (38.8)	2658 (34.8)	9467 (40.1)	2198 (38.7)	9928 (38.8)
	<1 time/day	17,273 (55.2)	4469 (58.5)	12,804 (54.2)	3148 (55.5)	14,125 (55.2)
	missing	1874 (6.0)	516 (6.8)	1358 (5.7)	327 (5.8)	1547 (6.0)
Frequency of vegetable/fruit intake	≥1 time/day	23,508 (75.2)	5495 (71.9)	18,013 (76.2)	42.7 (74.2)	1931 (75.4)
	<1 time/day	6075 (19.4)	1697 (22.2)	4378 (18.5)	1175 (20.7)	4900 (19.1)
	missing	1690 (5.4)	451 (5.9)	1239 (5.2)	291 (5.1)	1399 (5.5)
Body mass index	Underweight < 18.5	2367 (7.6)	589 (7.7)	1778 (7.5)	410 (7.2)	1957 (7.6)
	Normal 18.5–24.9	21,433 (68.5)	5228 (68.4)	16,205 (68.6)	3750 (66.1)	17,683 (69.1)
	Overweight 25–29.9	5767 (18.4)	1367 (17.9)	4400 (18.6)	1157 (20.4)	4610 (18.0)
	Obese ≥ 30	732 (2.3)	203 (2.7)	529 (2.2)	141 (2.5)	591 (2.3)
	missing	974 (3.1)	256 (3.3)	718 (3.0)	215 (3.8)	759 (3.0)
Comorbidities	Malignancy	1383 (4.4)	351 (4.6)	1032 (4.4)	229 (4.0)	1154 (4.5)
	Heart disease	3785 (12.1)	972 (12.7)	2813 (11.9)	677 (11.9)	3108 (12.1)
	Stroke	4.7 (1.3)	88 (1.2)	319 (1.3)	76 (1.3)	331 (1.3)
	Hypertension	12,330 (39.4)	3107 (40.7)	9223 (39.0)	2302 (40.6)	10,028 (39.2)
	Diabetes mellitus	2819 (12.2)	896 (11.7)	2923 (12.4)	644 (11.4)	3175 (12.4)
	Joint disease/ Neuralgia	1242 (4.0)	369 (4.8)	873 (3.7)	242 (4.3)	1000 (3.9)
	Traumatic fracture	2024 (6.5)	567 (7.4)	1457 (6.2)	4.3 (7.1)	1621 (6.3)
	Respiratory disease	652 (2.1)	163 (2.1)	489 (2.1)	123 (2.2)	529 (2.1)
	Digestive disease	307 (1.0)	87 (1.1)	220 (0.9)	50 (0.9)	257 (1.0)
	Dysphagia	191 (0.6)	74 (1.0)	117 (0.5)	34 (0.6)	157 (0.6)

Table 2. *Cont.*

		All Participants	Subjective Food Store Availability		Objective Food Store Availability	
		(*n* = 31,273)	Low (*n* = 7643)	High (*n* = 23,630)	Low (*n* = 5673)	High (*n* = 25,600)
Depression	Non-depressed	18,831 (60.2)	4056 (53.1)	14,775 (62.5)	3381 (59.6)	15,450 (60.4)
	Depressed	7285 (23.3)	2247 (29.4)	5038 (21.3)	1364 (24.0)	5921 (23.1)
	missing	5157 (16.5)	1340(17.5)	3817 (16.2)	928 (16.4)	4229 (16.5)
Cognitive function	Decline	10,158 (32.5)	2673 (35.0)	7485 (31.7)	1902 (33.5)	8256 (32.3)
	Not decline	21,115 (67.5)	4970 (65.0)	16,145 (68.3)	3771 (66.5)	17,344 (67.8)
Incidence of functional disability	Non-certification	24,741 (79.1)	5800 (75.9)	18,941 (80.2)	4451 (78.5)	20,290 (79.3)
	Certification	6532 (20.9)	1843 (24.1)	4689 (19.8)	1222 (21.5)	5310 (20.7)

Categorical data are expressed as a number (%).

Table 3. Hazard ratios with 95% confidence intervals for incident functional disability with objective and subjective food store availability.

		Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Subjective food store availability	High	Reference	Reference	Reference	Reference
	Low	1.20 (1.13 to 1.27)	1.20 (1.13 to 1.26)	1.20 (1.13 to 1.26)	1.18 (1.11 to 1.25)
Objective food store availability	High	Reference	Reference	Reference	Reference
	Low	0.98 (0.92 to 1.05)	0.98 (0.92 to 1.04)	1.00 (0.93 to 1.06)	1.00 (0.94 to 1.08)

HR hazard ratio, CI confidence interval, ref reference group. Model 1: Adjusted for age and sex. Model 2: Model 1 + adjustments for sociodemographic status (education attainment, marital status, employment status, yearly income, living situation). Model 3: Model 2 + adjustments for environmental status (driving status, neighborly relationships, and population density). Model 4: Model 3 + adjustments for walking and going out (daily walking time and rate of going out), dietary food intake (frequency of fruit/vegetable and meat/fish intake), body mass index, and comorbidities (malignancy, heart disease, stroke, hypertension, diabetes mellitus, joint disease/neuralgia, traumatic fracture, respiratory disease, gastrointestinal disease, dysphagia, depression, and cognitive decline).

4. Discussion

Low subjective food store availability was associated with early onset of disability among community-dwelling older adults, but this was not the case for objective food store availability. The association remained after adjustments for age, sex, sociodemographic and environmental status, walking and going out, nutritional status, and comorbidities.

As reported by Tani et al., subjectively lower accessibility of healthy food stores measured was associated with mortality [10] and dementia [11], however, they did not examine the association of food store availability and disability. To our knowledge, this is the first report that utilized large-scale data to assess the relationship between food store availability and the incidence of functional disability among older community dwellers.

Earlier studies on food store availability were mainly cross-sectional studies that were carried out in areas of low population density, and by inference in environments with a low food store density (e.g., United States, but the United Kingdom is an exception) [22]. Our study was conducted in Japan within a setting with a substantially high population density and high density of food stores, compared with settings of similar studies in the West.

Objective and subjective food store availability appear to have different meanings. Food access has five dimensions, comprising availability, accessibility, affordability, accommodation, and acceptability [23,24]. In our study, objective food store availability evaluated only availability of food stores. We found an association between subjective (but not objective) food store availability and onset of disability. This pattern was consistent with findings from previous study, which showed that healthy outcomes were more strongly associated with subjective evaluations of availability but not with objective evaluations [25,26]. Another previous study revealed a high level of mismatch between perceived and objective indices (14%) [25]. Even in areas with low objective food store availability, it is possible for evaluations of subjective food store availability to be high among individuals who have high walking ability, access to public transportation and/or mobile catering options, a person or persons who shops for food on their behalf, or who can grow their own food.

We hypothesized that a food environment that is subjectively evaluated is a better representation of individual differences in self-cultivated food, shopping behaviors, or accepting food from people living close by; not all of these could be addressed by objective evaluation. Several conditions could influence subjective food store availability, for example, traffic around the store, the form of the sidewalk (inclination, stairs), store opening hours/days, security around the store, attributes of other shoppers and store staff, price and assortment of goods, and the store environment (spaciousness of the shop, easy entry, existing amenities such as washrooms and material resources) [27].

The association between subjective food store availability and incidence of functional disability persisted after adjusting for potential mediating factors in Model 4 and could be attributed to other unobserved factors. We speculate that improved food store availability promotes activities of daily living, such as selection of food items, shopping, carrying items, and cooking, which could contribute to maintenance of activities of daily living. Moreover, there is a possibility that we could not subjectively recognize the food stores that sell only low-variety, distasteful, and low-quality foods. Lack of dietary variety has been significantly associated with the progression of frailty in community-dwelling older persons [28]. If food store availability is poor, there is a tendency to stock up on canned foods and ready-to-eat foods and this causes dietary imbalance. Increased opportunities to eat a variety of foods and maintain a well-balanced diet might be responsible for the maintenance of physical status and cognitive function in our study.

Our results suffered from the risk of reverse causation. Participants with many comorbidities and declined physical function might answer low availability of subjective food store and move to a place near the food store. Model 4 included the comorbidities taking the problem into account.

A strength of our study was that we evaluated the impact of subjective, as well as objective, food store availability on disability, investigating these relationships in a high-density setting; using a relatively large sample size added to the statistical power in detecting associations. Nevertheless, there were several limitations in our study. Firstly, the type and size of food stores or the variety,

quality, and price of food items were not considered, all of which are possibly significant factors for making healthy food choices. Secondly, the study area may not necessarily be a reflection of Japan as a whole. It is thus necessary for our findings to be reproduced in other regions, particularly in a larger metropolis. Thirdly, home-delivery meals or food services were not taken into account. Fourthly, there is a possibility that food store availability is a product of unmeasured proxy variables related to regional characteristics, such as regional economic affluence and the number of facilities where people gather, which were not adjusted for in the analysis. Fifthly, our database does not contain any time-dependent variables such as the change of food access over 6 years. Sixthly, the self-reported questionnaire that evaluated subjective food store availability did not ask about any other fresh foods than fresh fruits and vegetables. However, we speculated that food stores that sell fresh fruits and vegetables are highly likely to sell other fresh foods.

Low subjective food store availability was associated with early onset of disability, but low objective food store availability was not. Accessibility of food stores might contribute to maintaining a disability-free life. Studies that evaluate the mechanisms involved in the variations in these indices of food store accessibility are required in the future.

Author Contributions: Conceptualization, R.M., H.W., K.M., H.S., S.N., and K.K. (Katsunori Kondo); methodology, R.M., Y.T., and K.K. (Katsunori Kondo); formal analysis, R.M.; data curation, N.S., M.H., and K.K. (Katsunori Kondo); writing—original draft preparation, R.M.; writing—review and editing, R.M. and Y.T.; supervision H.W., K.M., H.S., S.N., K.K. (Katsunori Kondo), Y.T., N.S., M.H., and K.K. (Kaori Kojima); project administration, R.M.

Funding: This work was supported by Health and Labour Sciences Research Grants of the Ministry of Health, Labour and Welfare of Japan (H30−Junkankitou−Ippan−004) and JST-OPERA program grant (JPMJOP1831).

Acknowledgments: We would like to thank the members of the Japan Gerontological Evaluation Study (JAGES) project.

Conflicts of Interest: The authors declare no conflicts of interest.

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International Journal of
Environmental Research and Public Health

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Article

Social Participation and Functional Decline: A Comparative Study of Rural and Urban Older People, Using Japan Gerontological Evaluation Study Longitudinal Data

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Received: 14 December 2019; Accepted: 15 January 2020; Published: 18 January 2020

Abstract: This study compared the relationship between social participation, including work, and incidence of functional decline in rural and urban older people in Japan, by focusing on the number and types of organizations older people participated in. The longitudinal data of the Japan Gerontological Evaluation Study (JAGES) that followed 55,243 individuals aged 65 years or older for six years were used. The Cox proportional hazards model was employed to calculate the hazard ratio (HR) of the incidence of functional decline over six years and the stratification of rural and urban settings. In this model, we adjusted 13 variables as behavioral, psychosocial, and functional confounders. The more rural and urban older people participated in various organizations, the more they were protected from functional decline. Participation in sports (HR: rural = 0.79; urban = 0.83), hobby groups (HR: rural = 0.76; urban = 0.90), and work (HR: rural = 0.83; urban = 0.80) significantly protected against the incidence of decline in both rural and urban areas. For both rural and urban older people, promoting social participation, such as sports and hobby groups and employment support, seemed to be an important aspect of public health policies that would prevent functional decline.

Keywords: social participation; work; functional decline; rural; urban

1. Introduction

A strategy of active ageing [1], by linking the key policy domains of employment, pension, retirement, health, and citizenship, provides a sound basis to respond to the challenges presented by population ageing [2]. In recent times, the practical challenge has been to open up the innovative policy

spaces that might make active ageing not only thinkable but also achievable [3]. In European countries, the Active Aging Index (AAI) tool measures the untapped potential of older people for active and healthy aging across countries [4]. The AAI consists of four domains: employment, participation in society; independent, healthy, and secure living; and capacity and enabling environment for active ageing [4,5].

The social participation of older people, one of the domains of AAI [4,5], is a key factor of "successful aging" [6] and an important element of "active aging" [7]. Social participation is one of the core indicators of "age-friendly cities" proposed by the World Health Organization in recent years [8]. When considering public health services in a rapidly aging society, social participation is highlighted as a modifiable target of health interventions.

In many longitudinal studies, social participation has been reported as effective for health outcomes such as functional disability [9–13], cognitive disability [14–16], instrumental activities of daily living decline [17–19], and basic activities of daily living decline [20]. Among them, some studies focused on the number and types of organizations in which older people participated [10,13,16–18]. These studies suggested that older people who participate in more organizations are healthier than those who do not participate, and that the relationships between social participation and health varied according to the types of organization they participate in.

However, these studies [10,13,16–18] do not consider two issues. First, these studies do not consider "work" as a kind of social participation. According to the Organization for Economic Co-Operation and Development (OECD) scoreboard for older workers, older workers aged 65–69 years increased from 20.3% to 25.5% between 2006 and 2016 and from 12.0% to 14.6% at age 70–74 years during the same period, in OECD member countries [21]. However, recommendations made by the Council on Aging and Employment Policies [22] encourage supporting the employment of older people. In AAI, work and social participation are separate domains, but these are also defined as the actual experience of active aging [4,5]. Considering these circumstances, it is necessary to include work in social participation in the analysis of the number and types of organizations in which older people participated. Second, these studies do not consider residential environments, such as rural and urban areas. Generally, older people living in rural areas suffer with more depression [23], lower levels of basic activities of daily living [20], and a higher risk of developing disability [24] compared to those living in urban areas. In addition, the life expectancy is shorter in rural areas, and the difference between urban and rural areas is widening [25]. Previous studies [13,26] showed that rural older people were less socially active than urban older people. However, previous studies state that bonding social capital comprising a connection between community members is often stronger among rural older adults, resulting in community strength [27,28]. In addition, environmental factors such as neighborhood socioeconomic status and access to services and transportation differ in rural and urban areas [29]. Furthermore, the relationship between social participation and health outcomes, such as depression [23] and self-rated health [26,30], also differs. These may be the reasons why rural older people are unhealthier than urban older people. The relationship between social participation and functional decline may differ between rural and urban areas; however, such a relationship has not been clarified.

Thus, we aimed at clarifying whether there were differences between rural and urban areas in the relationship between social participation, including work, and incidence of functional decline. This study was conducted to inform public health policies that could prevent the need for long-term care of older individuals residing in rural and urban areas, which have different environmental factors.

2. Materials and Methods

2.1. Data

We used longitudinal data from the Japan Gerontological Evaluation Study (JAGES). JAGES is one of the few population-based gerontological repeated surveys in Japan focused on the social

determinants of health and the social environment [31,32]. From August 2010 to January 2012, self-reported questionnaires were mailed to 95,827 community-dwelling independent individuals aged 65 years and older who were not eligible to receive benefits from public long-term care insurance services. They were randomly selected from 13 municipalities, including rural and urban areas. Overall, 62,418 people participated (response rate, 65.1%) in the survey called JAGES2010. They were followed up for about six years (minimum 5.2 years; maximum 6.4 years). Of the total respondents (response rate 65.1%), 54,539 (87.4%) were successfully linked to the incident records of long-term care insurance certification. We excluded 7223 responses for the following reasons: (i) missing information on address (n = 101) and activities of daily living (ADL) (n = 1482); and (ii) having physical or cognitive disabilities reported in their questionnaires (n = 988). Moreover, 4662 respondents in long-term care within two years were removed to avoid the possibility of reverse causality (i.e., the possibility that people who were at high risk of functional decline did not participate socially). The final number of participants in this analysis was 47,306.

Ethical approval for the study was obtained from the Nihon Fukushi University Ethics Committee (application number: 10–05), the National Center for Geriatrics and Gerontology (application number: No. 992-2), and Chiba University Ethics Committee (application number: No. 2493).

2.2. Dependent Variable

The dependent variable was the incidence of functional decline during the follow-up period. The incidence of functional decline was defined by medical certification for Long-Term Care Insurance. Certification of decline is based on the formal evaluation of the need for Long-Term Care according to uniform criteria applied throughout Japan, and comprises both a home-visit interview, as well as the written opinion of a primary physician [33]. This formal evaluation is based on a standardized multistep assessment of functional and cognitive impairments [33]. We obtained information on the certification of long-term needs, death, and moving out of the study area, from the long-term care insurance database maintained by the municipalities. These criteria for determining the onset of functional decline have been used in previous epidemiological studies [4–6].

2.3. Independent Variable

The independent variable was social participation. With reference to previous research [5], social participation was classified into the following six types: neighborhood groups (local community), hobby groups (hobby), sports groups or clubs (sports), industrial groups (industry), volunteer groups (volunteer), and senior citizen clubs (citizen). Furthermore, we considered work (work) as a form of social participation and therefore analyzed seven types of organizations in this study.

Participation in organizations other than work was assessed by using the following question: "How often do you participate in the following clubs or groups?". Participants were given the following choices: "almost every day", "twice or thrice a week", "once a week", "once or twice a month", "a few times a year" and "never". The response was categorized as "yes" if individuals selected any of the five options from "a few times a year" to "almost every day", and "no" if they selected "never". Participation in work was assessed by using the following question: "What is your current working status?". Participants were given the following choices: "working", "retired and not working now" and "never had a job". The response was categorized as "yes" if the participants answered "working", and "no" if they answered "retired and not working now" or "never got a job".

The total number of types of organizations each participant participated in was tallied, and participation was categorized as 0 (no participation), 1, 2, or ≥3 organizations, or "missing". If the response to participation in all organizations was missing, we deemed it as "missing" category in this analysis. The organizations particularly unique to Japan among the types named above are senior citizen clubs. Japan's senior citizens clubs conduct a wide range of activities, including group activities such as sports, hobbies, cultural activities, and performing arts.

2.4. Covariates

Based on a previous study [10], sex, age, annual equivalized income, educational attainment, marital status, and self-reported medical conditions were considered potential confounding factors that may correlate with social participation and incidence of functional disability. In addition, behavioral, psychosocial, and physiological factors were also used as covariates and potential mechanisms influencing health and social participation. Smoking, alcohol consumption, daily walking time, and frequency of going outdoors were assessed as behavioral factors. Depression (Geriatric Depression Scale), emotional support, instrumental support, and frequency of meeting friends were assessed as psychosocial factors. Instrumental activity of daily living (IADL) was assessed as a functional factor. All variables were categorized as shown in Table 1 and set as dummy variables. A "missing" category was used in the analysis to account for missing responses to questions.

2.5. Classification of Rural and Urban Settings

The definition of functional urban areas from the OECD metropolitan database [34] was used to classify rural and urban settings. The definition of urban areas in OECD countries uses population density to identify urban cores, and travel-to-work flows to identify the hinterlands whose labor market is highly integrated with the cores. The methodology consisted of the three following main steps: (1) identification of core municipalities through gridded population data; (2) connecting noncontiguous cores belonging to the same functional urban area; and (3) identification of urban hinterlands. This methodology makes it possible to compare functional urban areas of similar size across different countries and classifies functional urban areas according to population size into the following four types: (1) small urban areas (with a population below 200,000 people); (2) medium-sized urban areas (with a population between 200,000 and 500,000); (3) metropolitan areas (with a population between 500,000 and 1.5 million); and (4) large metropolitan areas (with a population of 1.5 million or more). From the OECD's four functional urban areas, all cities, including metropolitan and large metropolitan areas, were designated urban areas in this study, and all others were designated rural areas. In this study, eight municipalities were designated as rural, and five municipalities were designated as cities.

2.6. Statistical Analysis

First, we conducted a chi-square test to compare variables between rural and urban males and females. As the sample size in this study is very large, we calculated Cramer's V as the effect size in addition to the *p*-value. The criteria for Cramer's V are 0.1 for small, 0.3 for medium, and 0.5 for large. Second, the Cox proportional hazards model was employed to calculate the hazard ratios (HRs) and 95% confidence intervals (CI) of the incidence of functional decline over six years, stratified by rural, and urban settings. In each model, nonparticipation in an organization was set as the referent category. In the analysis of the number or types of organization older people participate in, we conducted a trend test. Further, six types of social participation were introduced in each model separately. The following two models of analysis were used: a regression analysis was performed with simultaneous forced entry of sex, age, equivalent income, educational attainment, marital status, and self-reported medical conditions as covariates (Model 1). Model 2 added the following confounding factors to Model 1: smoking, alcohol consumption, walking time, frequency of going outdoors, Geriatric Depression Scale, emotional support, instrumental support, frequency of meeting friends, and IADL. Finally, to confirm the robustness of our finding, we performed a complete case analysis, excluding patients missing any of the variables used in the analysis. STATA V.15 (Stata Corp, College Station, TX, USA) was used to conduct a statistical analysis, with a significance level of 5%.

Table 1. Baseline characteristics of respondents (2010–2012).

Variables		Rural (n = 15,083)		Urban (n = 32,223)		p-Value (Cramer's V)
		n	%	n	%	
Sex	Male	6758	44.8	15,163	47.0	<0.001
	Female	8325	55.2	17,063	53.0	(0.02)
Age (years)	65–69	4287	28.4	9676	30.0	<0.001 (0.04)
	70–74	4536	30.1	10,343	32.1	
	75–79	3470	23.0	7257	22.5	
	80–84	1973	13.1	3611	11.2	
	85+	817	5.4	1336	4.2	
Equivalent income (million yen)	Low (<2.0)	7127	47.3	11,815	36.7	<0.001 (0.13)
	Middle (2.0–3.9)	3988	26.4	11,321	35.1	
	High (≥4.0)	939	6.2	3616	11.2	
	Missing	3029	20.1	5471	17.0	
Educational attainment (years)	<10	8404	55.7	14,103	43.8	<0.001 (0.12)
	10–12	4432	29.4	11,182	34.7	
	≥13	1853	12.3	6255	19.4	
	Missing	394	2.6	683	2.1	
Marital status	Married	10,611	70.3	23,315	72.4	<0.001 0.04
	Single	4111	27.3	8480	26.3	
	Missing	361	2.4	428	1.3	
Self-reported medical conditions	Illness	10,267	68.1	21,859	67.8	0.243 (0.01)
	No illness	3508	23.2	7677	23.8	
	Missing	1308	8.7	2687	8.4	
Smoking	Never smoked	8440	56.0	17,174	53.3	<0.001 (0.04)
	Past smoker	3566	23.6	8649	26.9	
	Current smoker	1437	9.5	3330	10.3	
	Missing	1640	10.9	3070	9.5	
Alcohol consumption	Never drank	9122	60.5	18,420	57.2	<0.001 (0.03)
	Past drinker	440	2.9	1021	3.2	
	Current drinker	4684	31.1	10,836	33.6	
	Missing	837	5.5	1946	6.0	
Walking time (per day)	>90 min	2515	16.7	5004	15.5	<0.001 (0.05)
	60–90 min	2130	14.1	5029	15.6	
	30–60 min	4558	30.2	10,960	34.0	
	<30 min	4905	32.5	9341	29.0	
	Missing	975	6.5	1889	5.9	
Frequency of going outdoors	Almost everyday	6607	43.8	18,496	57.4	<0.001 (0.15)
	2–3 times/week	4601	30.5	8288	25.7	
	About once/week	1755	11.6	2253	7.0	
	Rarely	1351	9.0	1384	4.3	
	Missing	769	5.1	1802	5.6	
Depression	No depression	9313	61.8	19,977	62.0	0.002 (0.02)
	Depressive tendency	2613	17.3	5343	16.6	
	Depression	822	5.4	1595	4.9	
	Missing	2335	15.5	5308	16.5	
Emotional support	Available	13,052	86.5	28,584	88.7	<0.001 (0.03)
	Not available	1209	8.0	2310	7.2	
	Missing	822	5.5	1329	4.1	
Instrumental support	Available	12,369	82.0	26,971	83.7	<0.001 (0.03)
	Not available	1906	12.6	3906	12.1	
	Missing	808	5.4	1346	4.2	

Table 1. *Cont.*

Variables		Rural (*n* = 15,083)		Urban (*n* = 32,223)		*p*-Value (Cramer's V)
		n	%	*n*	%	
Frequency of meeting friends	Almost everyday	2247	14.90	4347	13.5	<0.001 (0.04)
	2–3 times/week	3513	23.30	7206	22.4	
	About once/week	2461	16.30	5293	16.4	
	1–2 times/month	2914	19.30	6049	18.8	
	A few times a year or less	2841	18.80	7251	22.5	
	Missing	1107	7.40	2077	6.4	
Instrumental activity of daily living (IADL)	Not decline	6073	40.3	12,578	39.0	0.025 (0.01)
	Decline	7230	47.9	15,856	49.2	
	Missing	1780	11.8	3789	11.8	
Number of types of organizations	0	3187	21.1	7700	23.9	<0.001 (0.06)
	1	3420	22.7	7964	24.7	
	2	2691	17.8	6173	19.1	
	≥3	5227	34.7	9588	29.8	
	Missing	558	3.7	798	2.5	
Type of social participation						
Local community	Nonparticipation	5909	39.2	14,781	45.9	<0.001 (0.07)
	Participation	5886	39.0	10,802	33.5	
	Missing	3288	21.8	6640	20.6	
Hobby	Nonparticipation	6656	44.1	13,411	41.6	<0.001 (0.05)
	Participation	5430	36.0	13,212	41.0	
	Missing	2997	19.9	5600	17.4	
Sports	Nonparticipation	8540	56.6	18,242	56.6	0.001 (0.02)
	Participation	3272	21.7	7375	22.9	
	Missing	3271	21.7	6606	20.5	
Industry	Nonparticipation	8791	58.3	19,293	59.9	<0.001 (0.04)
	Participation	2020	13.4	4829	15.0	
	Missing	4272	28.3	8101	25.1	
Volunteer	Nonparticipation	8787	58.3	19,803	61.5	<0.001 (0.03)
	Participation	2292	15.2	4526	14.0	
	Missing	4004	26.5	7894	24.5	
Citizen	Nonparticipation	7842	52.0	19,244	59.7	<0.001 (0.10)
	Participation	4247	28.2	6165	19.1	
	Missing	2994	19.8	6814	21.2	
Work	Nonparticipation	9002	59.7	21,572	67.0	<0.001 (0.10)
	Participation	3397	22.5	7166	22.2	
	Missing	2684	17.8	3485	10.8	

3. Results

Table 1 presents the descriptive statistics of rural and urban variables. Of the 47,306 respondents included in the analyses, 21,921 were male and 25,385 were female. Of the 21,921 males, 6758 lived in rural and 15,163 lived in urban settings. Of the 25,385 females, 8375 lived in rural and 17,060 lived in urban settings. The average age of the rural and urban older people was 73.8 (standard deviation (SD), 5.9) and 73.3 (SD, 5.6) years, respectively. Of the respondents in rural and urban areas, 2399 (15.9%) and 4018 (15.3%) reported functional decline, respectively. The average tracking period was 2028.1 days (SD = 364.1) for rural and 1951.8 days (SD = 361.7) for urban older peoples. The comparison of variables across rural and urban areas revealed that there were many urban–rural differences. However, the sample size for this study was so large that even minor differences could result in statistical differences. In fact, Cramer's V in the chi-square test between almost all variables was judged to be very small, and the realistic effect size was small. However, describing the difference

between rural areas and cities when the effect size is 0.1 or more indicated that older people in rural areas had a lower equivalent income ($p < 0.001$), lower educational attainment ($p < 0.001$), and went outdoors less frequently ($p < 0.001$) than those in urban areas. Although the effect size was small, the distribution of the number of organizations in which older people participated differed between rural and urban areas ($p < 0.001$). When types of social participation were analyzed, rural older people participated a lot more in senior citizen clubs ($p < 0.001$) than urban older people. The distribution of participation in work differed between rural and urban areas ($p < 0.001$; Cramer's V = 0.1); it was thought to be due to the missing category.

Table 2 presents the results of a Cox proportional hazards model analysis of the different types of organizations and incidence of functional decline. In the crude model and Model 1, a "dose–response" relationship was seen both among rural and urban areas, with progressively lower HRs as the number of different types of organizations increased. In Model 2 for rural older people, the HRs were 0.94 (95% CI: 0.84–1.05) for participation in one, 0.85 (0.75–0.97) for participation in two, and 0.76 (0.67–0.86) for participation in three or more different types of organizations, with the significant difference disappearing only for participation in one type of organization. For urban older people, the HRs were 0.92 (95% CI: 0.85–0.99) for participation in one, 0.87 (0.80–0.96) for participation in two, and 0.82 (0.75–0.89) for participation in three or more different types of organizations, with the statistical significance for one or more different types of organizations. In other words, older people in urban areas were protected from functional decline through one type of participation. On the other hand, older people in rural areas required more than one type of participation, but older people in rural areas had lower HRs when participating in more than two types of organizations than older people in urban areas.

Table 2. HRs for participation in one, two, and three or more different types of organizations.

Rural	Crude Model	Model 1	Model 2
	HR (95% CI)	HR (95% CI)	HR (95% CI)
0	1.00 Ref	1.00 Ref	1.00 Ref
1	0.71 * (0.64–0.79)	0.87 * (0.78–0.97)	0.94 (0.84–1.05)
2	0.57 * (0.50–0.64)	0.75 * (0.66–0.85)	0.85 * (0.75–0.97)
≥3	0.43 * (0.39–0.49)	0.62 * (0.56–0.70)	0.76 * (0.67–0.86)
Trend p	$p < 0.05$	$p < 0.05$	$p < 0.05$
Urban	**Crude model**	**Model 1**	**Model 2**
	HR (95% CI)	**HR (95% CI)**	**HR (95% CI)**
0	1.00 Ref	1.00 Ref	1.00 Ref
1	0.69 * (0.64–0.75)	0.85 * (0.79–0.91)	0.92 * (0.85–0.99)
2	0.59 * (0.55–0.65)	0.77 * (0.71–0.84)	0.87 * (0.80–0.96)
≥3	0.48 * (0.44–0.52)	0.67 * (0.62–0.72)	0.82 * (0.75–0.89)
Trend p	$p < 0.05$	$p < 0.05$	$p < 0.05$

HR: Hazard ratio; CI: confidence interval; Ref: reference. * $p < 0.05$. Model 1: Crude model + sex, age, equivalent income, educational attainment, marital status, and self-reported medical conditions. Model 2: Model 1 + smoking, alcohol consumption, walking time (per day), frequency of going outdoors, depression, emotional support, instrumental support, frequency of meeting friends, and IADL.

The results of the complete case analysis are shown in Table S1. The results of the complete case analysis, excluding patients missing any of the variables used in the analysis were similar to those when the "missing" category was used in the analysis to account for missing responses to questions. The full modeling results in Model 2 were presented in Table S2. In this study, Model 2 added social networks such as emotional support, instrumental support, and frequency of meeting friends. Rural and urban older people who could not avail emotional support were not protective against functional decline compared with those who could avail it. Furthermore, urban older people who could not avail instrumental support were not protective against functional decline compared with those who could

avail it, but this was not the case in rural areas. The frequency of meeting friends was not statistically significant in rural and urban areas.

Table 3 presents the results of the Cox proportional hazards model analysis of the type of social participation and incidence of functional decline. Almost all types of organizational participation were strongly protective against functional decline, but senior citizen clubs had the opposite relationship in the crude model. Similarly, many types of organizational participation were protective against functional decline in Model 1. In Model 2 for rural older people, participation in hobbies (HR = 0.76; 95% CI: 0.68–0.85), sports (HR = 0.79; 95% CI: 0.69–0.89), work (HR = 0.83; 95% CI: 0.76–0.91), and local community (HR = 0.86; 95% CI: 0.77–0.95) was found to be protective against the incidence of decline. For urban older people, participation in work (HR = 0.80; 95% CI: 0.70–0.91), sports (HR = 0.83; 95% CI: 0.77–0.91), and hobbies (HR = 0.90; 95% CI: 0.84–0.97) was found to be protective against the incidence of decline.

Table 3. HRs for type of social participation (reference: nonparticipation in each organization).

Rural	**Crude Model**	**Model 1**	**Model 2**
	HR (95% CI)	**HR (95% CI)**	**HR (95% CI)**
Local Community	0.59 * (0.54–0.65)	0.77 * (0.70–0.86)	0.86 * (0.77–0.95)
Hobby	0.57 * (0.52–0.64)	0.61 * (0.60–0.75)	0.76 * (0.68–0.85)
Sports	0.62 * (0.55–0.70)	0.70 * (0.62–0.78)	0.79 * (0.69–0.89)
Industry	0.67 * (0.58–0.78)	0.92 (0.84–1.01)	1.01 (0.87–1.18)
Volunteer	0.62 * (0.54–0.72)	0.77 * (0.67–0.89)	0.89 (0.77–1.03)
Citizen	1.40 * (1.27–1.54)	0.94 (0.85–1.03)	1.02 (0.93–1.13)
Work	0.48 * (0.42–0.54)	0.74 * (0.65–0.84)	0.83 * (0.76–0.91)
Urban	**Crude Model**	**Model 1**	**Model 2**
	HR (95% CI)	**HR (95% CI)**	**HR (95% CI)**
Local Community	0.70 * (0.65–0.75)	0.84 * (0.79–0.90)	0.95 (0.88–1.01)
Hobby	0.70 * (0.66–0.75)	0.78 * (0.73–0.84)	0.90 * (0.84–0.97)
Sports	0.60 * (0.55–0.65)	0.73 * (0.67–0.79)	0.83 *(0.77–0.91)
Industry	0.81 * (0.74–0.89)	0.90 (0.78–1.05)	1.04 (0.95–1.15)
Volunteer	0.66 * (0.60–0.73)	0.80 * (0.73–0.89)	0.94 (0.85–1.04)
Citizen	1.37 * (1.28–1.47)	0.89 * (0.83–0.96)	0.99 (0.92–1.07)
Work	0.50 * (0.46–0.55)	0.80 *(0.73–0.87)	0.80 * (0.70–0.91)

HR: Hazard ratio; CI: confidence interval; Ref: reference. * $p < 0.05$. Model 1: Crude model + sex, age, equivalent income, educational attainment, marital status, and self-reported medical conditions. Model 2: Model 1 + smoking, alcohol consumption, walking time (per day), frequency of going outdoors, depression, emotional support, instrumental support, frequency of meeting friends, and IADL.

The results of the complete case analysis are shown in Table S3. In the complete case analysis for rural older people, the HR for participation in work and local community was below 1.00, but the statistical significance disappeared. Further, the results of the complete case analysis for urban older people, excluding patients missing any of the variables used in the analysis, were similar to those when the "missing" category was used in the analysis, to account for missing responses to questions. The full modeling results in Model 2 were presented in Table S4. The result of the social networks, such as emotional support, instrumental support, and frequency of meeting friends, added in Model 2, was similar to the analysis of the number of organizations.

4. Discussion

To the best of our knowledge, this is the first longitudinal study to compare the relationship between the number and type of organizations, including work, and incidence of functional decline in rural and urban areas separately.

In all, two findings were obtained from this study: (1) a "dose–response" relationship was seen both among rural and urban areas, with progressively lower HRs as the number of different types of

organizations increased; and (2) participation in sports, hobbies, and work were protective against incidences of decline in both rural and urban areas. In this study the classification of rural and urban areas is as proposed by the OECD. Previous studies have used population density and national classification; however this study adopted an international classification system. Even when classifying areas by population density, the results of this study were almost the same.

The analysis of the number of organizations revealed the HRs of the number of types of organizations progressively decreased as the number of participating organizations. This supports previous studies, including those measuring other health outcomes [10,13,16–18]. In this study, HRs were lower when participated in two or more types of organizations in rural areas than in urban areas. The social relationships specific to rural areas may be the reason why older people living in these areas need to join more than one organization. Previous studies have indicated that bonding social capital comprising a connection between community members is often stronger among rural older adults, resulting in community strength [27,28]. In this study, participation in local community organizations was higher in rural areas than in urban areas. However, excessive bonding social capital tends to have negative effects [35]. According to the systematic review of the negative health effects of social capital [35], there are downsides to social capital that emerge in the context of strong bonding social capital, but not in weak bridging social capital. (1) Strong bonding ties impose heavy obligations on community members by following a dominant social hierarchy and social norms, and it exclude outsiders. (2) The lack of bridging SC is crucial in socioeconomically disadvantaged communities. (3) In such settings, the connection of members to outside sources of support is even more important. In closed communities, such as those in rural areas, participation in more organizations may improve bridging social capital. For the above reasons, older people in rural areas may benefit from participation in a greater number of organizations.

Many types of organizational participation were protective against functional decline in Model 1, which included factors such as age, equivalent income, educational attainment, marital status, and self-reported medical conditions. However, in Model 2, factors such as behavioral, psychosocial, and functional confounders, as well as participation in sports, hobbies, and work, were protective against incidences of decline.

This is the first longitudinal study to compare work with other community organizations by defining work as a type of social participation. Previous longitudinal studies focusing on the relationship between work and health outcomes among older people have examined work alone [20,36,37], and comparisons with other community organizations have been cross-sectional studies [38]. Given the current challenges posed by a rapidly declining birthrate and aging population, it is necessary to develop a social structure where many older people work [39]. Working support for older people is expected to contribute not only to a substantial increase in the labor force but also to a decrease in the number of older people requiring care [39]. This study showed that working support and improvement of working environment could be public health policies that would prevent the need for the provision of long-term care in rural and urban areas. In longitudinal studies of work and health outcomes [20,36,37], work is generally considered good for health. However, poor-quality work [36] is not good for health; therefore, additional analysis is necessary, since this research did not consider the type of work.

The results indicating that participation in sports and hobby groups were protective against disability were similar to previous studies [10]. According to this result, a good public health policy would include local government provision of regular opportunities for social participation in sports and hobbies in both rural and urban areas. Participation in sports and hobby groups has also been reported to prevent other poor health outcomes [16,18,19]. Previous studies have shown that older people in rural areas were unhealthier than older people in urban areas [20,24,29,30], but in this study, there was no difference in the incidence of functional disability between older people in rural and urban areas. The reason may be that there was no difference in the urban–rural participation rates in sports and hobby groups among the participants of this study. Even in rural areas, promoting

participation in groups such as sports and hobbies groups could prevent the incidence of functional decline. In Japan, the salon-type community intervention [40] has been implemented as one of the ways to promote social participation. These salons, managed by local volunteers, are held once or twice a month in communal spaces within walking distance of community members' homes, and older people can meet and interact with others through enjoyable, relaxing, and sometimes educational programs [40]. Moreover, participation in local community organizations was only protective against decline in rural older people in this study. In the scoping review by Carver et al. [41], older people who lived in rural areas had many opportunities to engage in community-association activities, and through such social participation, a sense of belonging was created. They suggested that such social participation is important for achieving successful aging in rural areas.

The preventive effects against functional decline of the number and types of social participation were almost the same among both rural and urban areas in this study. Quite a few studies on age-friendly cities showed that urban areas are suitable for active aging [42]. One of the reasons for that may be a larger quantity of amenities and possibilities for social interactions/organizations and easier access to those in urban areas compared to rural areas. It could be an effective intervention that older people move to urban areas when their health/physical ability starts to decline. Nowadays, the compact city, i.e., located in the rural city center, but short-distance from urban functions, trials have begun in Japan [43,44], and their effectiveness is expected to be verified.

This study has two strengths. First, this is the first study to target older people in many municipalities, including rural and urban areas, in contrast to previous studies that only focused on the number and type of organization in which older people participated [10,13,16–18]. Second, the data used in this study was collected over a long period (about six years) and excluded respondents receiving long-term care within two years, thereby removing the possibility of reverse causality (i.e., the possibility that people who had a high risk of functional decline did not participate socially).

This study had three limitations. First, we did not consider the frequency of social participation. It has been reported that the relationship between social participation and health outcomes differs depending on the frequency of social participation [16,18,38]. However, this research emphasized a comparison between rural and urban areas in line with a previous study [10]. Second, we did not consider the older people's role of the organization they participated in, such as being a member or a leader. A leading role in an organization has an additional effect on social participation and health outcomes [15,45]. Finally, this study only focuses on the differences between rural and urban areas; however, there may be other environmental characteristics to consider. The NuAge Study showed environmental factors associated with social participation of older people vary by living areas, such as metropolitan, urban, and rural areas [29]. In Japan, it was reported that environmental factors such as access to facilities, shops, and parks and sidewalks were related to participation in sports groups [46]. Future longitudinal or interventional studies focusing on rural and urban environmental improvement will be needed.

5. Conclusions

We compared the relationship between social participation, including work and incidence of functional decline in rural and urban older people, to inform public health policies that would prevent functional decline in older individuals residing in Japan. Participating in various organizations protected older people from functional decline, and, thus, it might be essential to facilitate the benefits of such participation to both rural and urban older people. Furthermore, participation in sports, hobbies, and work was protective against incidences of decline in both rural and urban regions. For both rural and urban older people, promoting social participation, such as sports and hobbies groups and employment support, seems to be an important aspect of public health policies that would prevent functional decline.

Supplementary Materials: The following are available online at http://www.mdpi.com/1660-4601/17/2/617/s1, Table S1: Complete case analysis: HRs for participation in one, two, and three or more different types of organizations, Table S2: The full modeling results for participation in one, two, and three or more different types of organizations in Model 2, Table S3: Complete case analysis: HRs for type of social participation (reference: nonparticipation in each organization), Table S4: The full modeling results for HRs for type of social participation (reference: nonparticipation in each organization).

Author Contributions: Conceptualization and methodology, K.I., T.T., and S.K.; validation, K.I. and T.T.; formal analysis, K.I.; data curation, T.T.; writing—original draft preparation, K.I.; writing—review and editing, T.T. and S.K.; supervision, S.J., Y.N., and K.K.; project administration, K.K. All authors have read and agreed to the published version of the manuscript.

Funding: This study used data from JAGES (the Japan Gerontological Evaluation Study). This study was supported by Grant-in-Aid for Scientific Research (15H01972, 15H04781, 15H05059, 15K03417, 15K03982, 15K16181, 15K17232, 15K18174, 15K19241, 15K21266, 15KT0007, 15KT0097, 16H05556, 16K09122, 16K00913, 16K02025, 16K12964, 16K13443, 16K16295, 16K16595, 16K16633, 16K17256, 16K17281, 16K19247, 16K19267, 16K21461, 16K21465, 16KT0014, 17K04305, 17K34567, 17K04306, 25253052, 25713027, 26285138, 26460828, 26780328, 18H03018, 18H04071, 18H03047, 18H00953, 18H00955, 18KK0057, 18074040, 19H03901, 19H03915, 19H03860, 19K04785, 19K10641, 19K11657, 19K19818, 19K19455, 19K24060, 19K20909) from JSPS (Japan Society for the Promotion of Science); Health Labour Sciences Research Grants (H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001 H28-Choju-Ippan-002, H28-Ninchisyou-Ippan-002, H29-Chikyukibo-Ippan-001, H30-Jyunkankinado-Ippan-004, 18H04071, 19FA1012, 19FA2001) from the Ministry of Health, Labour and Welfare, Japan; the Research and Development Grants for Longevity Science from Japan Agency for Medical Research and development (AMED) (JP17dk0110027, JP18dk0110027, JP18ls0110002, JP18le0110009, JP19dk0110034, JP19dk0110037), the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29-42, 30-30, 30-22); Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST); a grant from the Japan Foundation For Aging And Health (J09KF00804), a grant from Innovative Research Program on Suicide Countermeasures (1-4), a grant from Sasakawa Sports Foundation, a grant from Japan Health Promotion & Fitness Foundation, a grant from Chiba Foundation for Health Promotion & Disease Prevention, the 8020 Research Grant for fiscal 2019 from the 8020 Promotion Foundation (adopted number: 19-2-06), a grant from Niimi University (1915010), grants from Meiji Yasuda Life Foundation of Health and Welfare. The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Acknowledgments: We would like to thank the study participants. We would also like to thank Hanazato (Chiba University) for teaching us the classification of rural and urban settings.

Conflicts of Interest: The authors declare no conflicts of interest.

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International Journal of
Environmental Research and Public Health

MDPI

Article

Change in Municipality-Level Health-Related Social Capital and Depressive Symptoms: Ecological and 5-Year Repeated Cross-Sectional Study from the JAGES

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Received: 28 April 2019; Accepted: 5 June 2019; Published: 8 June 2019

Abstract: Prevalence of depressive symptoms is lower in communities with greater social capital (SC). However, it is unclear whether a prevalence of depressive symptoms will decrease in communities where SC has increased. We investigated the relationship between the changes in municipality-level SC and depressive symptoms by using 5-year repeated cross-sectional data from the Japan Gerontological Evaluation Study. In 2010 and 2016, self-reported questionnaires were mailed to functionally independent residents aged 65 years or older living in 44 municipalities; valid responses were received from 72,718 and 84,211 people in 2010 and 2016, respectively. All scores were aggregated at the municipality level. The dependent variable was the change in the prevalence of depressive symptoms that were diagnosed with a 15-item Geriatric Depression Scale. Independent variables were the score of change in health-related SC indicators, e.g., social participation, social cohesion, and reciprocity. A multiple regression analysis was employed. The average prevalence of depressive symptoms decreased from 28.6% in 2010 to 21.3% in 2016. The increases in the percentages of sports group participation (B, −0.356), and reciprocity scores (B, −0.597) were significantly associated with the decrease in the prevalence of depressive symptoms after adjusting for potential confounding variables. Our findings suggest that community SC might be an intervention for protecting depressive symptoms in municipalities.

Keywords: depression; older adults; population approach; municipality level; social capital; Japan Gerontological Evaluation Study

1. Introduction

Depression is the most common mental disorder (CMD) worldwide. According to the World Health Organization [1], the estimated prevalence of depression is 4.4%. According to the literature, depression in older adults has been associated with poor quality of life [2], functional decline [3], dementia [4], and mortality [5]. Thus, preventing depression is a critical target.

Risk factors of depression in older adults include low education, acceptance of risky lifestyle practices (e.g., smoking, risk drinking, physical inactivity, and obesity), and chronic disease [6,7]. Recent findings have indicated that mental health including depression in late life might be protective in relation to social capital (SC) [8–11].

One should realize that SC is an umbrella term meaning that resources are accessed by individuals as a consequence of their membership status in a network or group [12]. The conception of SC is often measured using civic engagement, individual and community social networks, and trust in the community [13], which can all be divided into structured, cognitive, bonding, and bridging [12]. Furthermore, SC has two levels: individual and group. Individual-level SC refers to resources that individuals can access through individual egocentric networks. Group-level SC is an asset of the entire network and benefits individuals included therein [12].

Within SC, health-related SC has been commonly used to examine associations with health-related outcomes, including depressive symptoms [14]. Earlier works from De Silva [8] and Ehsan and De Silva [9] have reported a strong inverse correlation between individual-level cognitive SC and CMD. At the community level, researchers have reported that CMD was low where community-level cognitive SC was high for seven cross-sectional studies [8,9].

Much of the literature on the community level has been cross-sectional, and the scarcity of community SC and CMD research has been noted [8,9]. Ecological research is appropriate to assess the impact on an entire population that profits from the direct effect of SC on individuals [15]. Although SC has been demonstrated to be a modifiable factor [16,17], research has not determined whether decreases in community-level depression are related to increases in community SC.

The purpose of this study was to examine whether the prevalence of community-level depressive symptoms decreased in a community where health-related SC increased using an ecological design.

2. Methods

2.1. Data

We used repeated cross-sectional data derived from the Japan Gerontological Evaluation Study (JAGES). The JAGES is an ongoing cohort study investigating social and behavioral factors related to health decline, including mortality and onset of functional or cognitive impairment among individuals aged 65 years or older [18,19]. Our data were collected from two waves of the JAGES, namely, 2010-12 (2010) and 2016. The mean follow-up period was 5.3 years.

Self-reported questionnaires were mailed to independent residents not eligible to receive public long-term care insurance benefits. The questionnaires were mailed to 31 municipalities in the 2010 wave and 39 municipalities in the 2016 wave, and the questionnaires were collected from 112,123 and 196,436 participants, corresponding to response rates of 66.3% and 70.2%, respectively. Data from 21 municipalities were obtained at both time points, in 2010 (n = 80,318) and 2016 (n = 100,868), and we excluded (i) missing information on sex, age, depressive symptoms, and basic activity of daily living (BADL; 2010: n = 6056, 2016: n = 11,321) and (ii) individuals whose BADL was not independent (2010: n = 1544, 2016: n = 5336). In addition, ordinance-designated cities in Japan have wards with functions similar to municipalities. Therefore, we split the two ordinance-designated cities into 25 wards.

Consequently, we used data from 44 municipal units (n: 2010 = 72,718 (minimum: 352, maximum: 5915), 2016 = 84,211 (minimum: 418, maximum: 8721)). Random sampling methods were used in 34 municipal units, and complete enumeration survey methods were used in 10 municipalities.

From the 34 municipalities where the sampling methods were conducted, we tracked the participants of 2010 in 2016 to create panel data sets, and the data were oversampled.

Ethical approval for the study was obtained from the Nihon Fukushi University Ethics Committee (application number: 10-05), National Center for Geriatrics and Gerontology (application number: No. 992-2), and Chiba University Ethics Committee (application number: No. 2493).

2.2. Dependent Variables

For the dependent variables of this community-level ecological study, we calculated the difference between the prevalence of depressive symptoms by subtracting the depressive symptoms for 2010 from the depressive symptoms for 2016 for each municipal unit. We assessed depressive symptoms by using the Japanese short version of the Geriatric Depression Scale (GDS) (score range: 0–15; Cronbach's alpha = 0.80) developed for self-administrative surveys [20,21]. We followed the literature [22–24]; thus, mild or severe depressive symptoms (GDS ≥ 5) were the cutoff scores previously validated as a screening instrument for major depressive disorder with 96% sensitivity and 95% specificity [22].

2.3. Independent Variables

For the independent variables, we measured health-related SC in the 2010 survey and the 2016 survey, and the difference score was calculated by subtracting the scores for 2010 from the scores for 2016 for each municipal unit. We defined SC as "features of social organization, such as trust, norms, and networks, that can improve the efficacy of society by facilitating coordinated actions" [25], and health-related SC has been a commonly used concept in epidemiological studies [14]. We selected health-related SC based on the indicators in Saito et al. [14], which examined the validity of community-level SC for Japanese people 65 years or older.

Regarding social participation, we assessed the frequency of participation in volunteer groups, sports groups, and hobby groups [14]. We created two intervals. The first interval was as follows: <1 day/month and ≥1 days/month [10,14]. The second interval was as follows: <1 day/week and ≥1 days/week [26]. Regarding the frequency of contact with friends and acquaintances, this was divided into two categories: <1 day/month and ≥1 days/month [27]. Regarding social support, we surveyed emotional and instrumental support (i.e., providing and receiving). Social support was assessed by asking the following question "Do you have someone who listens to your concerns and complaints?" Providing instrumental support to others was evaluated using the question "Do you have someone you take care of when she or he is sick in bed?" These social support responses were dichotomized into yes and no [14].

In addition, we used SC scores developed by Saito et al. [14]. According to Saito's index, civic participation (five questions), social cohesion (three questions), and reciprocity (three questions) were calculated for each municipal unit. Civic participation refers to the level of residents' participation in community organizations and activities. Civic participation was originally comprised of five questions. However, because information on attachment to the community was not available in the 2010 wave, we calculated the score of civic participation based on three questions. Social cohesion pertains to the cognitive aspects of interpersonal trust. Reciprocity represents community social support.

2.4. Covariates

We age-standardized the all variables by applying direct methods to the Japanese demographical statistics of 1985, which the Ministry of Health, Labor and Welfare have been using as a standard of statistics [28]. For the adjusted variables, we measured socioeconomic status in the 2010 survey and the 2016 survey, and the score for 2010 was subtracted from the score for 2010 across each municipal unit. Socioeconomic status included change in proportion of living alone, change in proportion of people with an equivalized household income greater than 2 million yen [29], change in proportion of having an education level greater than 10 years [29], and change in the proportion of the employed.

2.5. Statistical Analysis

First, we compared the differences in the study variables between the two time points by using a paired-samples *t*-test. Second, we used multiple linear regression models to examine the association between change in health-related SC variables and change in depressive symptoms (GDS ≥ 5). The following two models were constructed. In the crude model, change in health-related SC and change in depressive symptoms were separately modeled, and Model 1 added the covariates of change for living alone, change in proportion with an education level (greater than 10 years), change in proportion of having income (greater than 2 million yen for equivalized household income), and change in employment compared with the crude model. Notably, we took advantage of the change in the two time points, which can control for time-invariant unobserved and observed confounding community characteristics [30]. Finally, in 34 municipal units out of 44 municipal units, we tracked the participants of 2010 in 2016 to create panel data sets. The data were oversampled and in 2016 for participants obtained in 2010, they show a survival bias that was one of the selection biases. For that reason, we conducted the comparison using an independent-samples *t*-test to assess whether there was any difference in the change over the 5 years in the group of the complete enumeration survey and the group comprised by some individuals in the oversampling survey. We added sex to the analysis of Model 1 in the multiple linear regression and further investigated the interaction with sex and each health-related SC. As a result, of the 14 items for health-related SC, only social cohesion showed a significant association with changes in municipal-unit-level depressive symptoms. For that reason, sex was analyzed collectively. All analyses were conducted using SPSS V. 25.0J (IBM Japan, Tokyo, Japan).

3. Results

Overall, the prevalence of depressive symptoms decreased in 2016 compared with 2010. Age-adjusted average prevalence of depressive symptoms decreased from 28.6% (standard deviation (SD): 3.4%) in 2010 to 21.3% (SD: 2.7%) in 2016.

Table 1 presents the age-adjusted comparison in 2010 and 2016 for each variable. Compared with 2010, in 2016, the percentages of respondents who were married, lived alone, had an educational history of more than 10 years, and were employed increased. Of the 14 health-related SC items, we observed an increase in nine items and a decrease in three items, and the association was significant.

Table 1. Age-adjusted descriptive statistics of community factors (municipal units = 44).

Variables	2010				2016					
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	Difference (2016–2010)	*p* Values
% Depressive symptoms [a]	23.2	39.5	28.6	3.4	16.3	27.9	21.3	2.7	−7.3	<0.001
% Married	60.1	78.3	71.5	4.9	60.2	80.2	72.5	4.8	0.9	0.003
% Living alone	8.0	27.1	14.9	4.9	9.2	31.3	17.0	5.2	2.1	<0.001
% Education ≥10 years	32.4	81.0	59.3	14.2	41.8	84.4	69.5	11.4	10.2	<0.001
% Equivalent income ≥2,000,000 JPY	34.2	66.3	52.2	8.9	37.1	63.8	51.6	7.4	−0.5	0.185
% Employed	15.9	35.9	23.7	4.1	22.7	46.1	31.0	4.6	7.4	<0.001
% Volunteer group [b] (≥1 per month)	7.7	15.4	11.4	1.7	10.9	20.2	15.7	1.8	4.3	<0.001
% Sports group [b] (≥1 per month)	11.4	31.6	24.2	4.3	19.9	39.4	30.7	4.6	6.4	<0.001
% Hobby group [b] (≥1 per month)	26.6	48.6	39.0	5.3	27.5	45.5	38.9	4.8	−0.1	0.869
% Volunteer group [b] (≥1 per week)	3.0	8.8	5.5	1.4	4.7	10.5	7.6	1.5	2.1	<0.001
% Sports group [b] (≥1 per week)	8.6	26.3	19.3	3.5	12.7	31.5	23.9	3.8	4.6	<0.001
% Hobby group [b] (≥1 per week)	15.4	32.2	24.5	3.8	16.3	29.5	24.2	3.3	−0.3	0.394
% Frequency of contact with friends [b] (≥1 per month)	67.3	82.5	73.4	3.6	66.5	81.6	72.2	3.8	−1.2	0.002
% Receiving emotional social support	89.3	96.4	93.7	1.4	92.1	97.0	94.7	1.2	1.1	<0.001
% Providing emotional social support	88.6	94.9	92.6	1.4	90.4	96.6	93.9	1.3	1.3	<0.001
% Receiving instrumental social support	86.6	97.0	94.0	2.4	87.4	97.4	94.7	2.1	0.7	<0.001
% Providing instrumental social support	81.0	90.7	87.2	2.2	81.0	90.4	85.5	2.1	−1.7	<0.001
Civic participation	41.1	75.0	61.3	8.3	47.2	84.5	69.0	8.4	7.7	<0.001
Social cohesion	143.3	182.7	161.0	10.1	138.2	172.9	158.7	9.0	−2.3	<0.001
Reciprocity	185.6	201.1	196.1	3.2	189.7	203.7	198.3	2.9	2.2	<0.001

SD: Standard deviation. * All factors were adjusted for age using the direct methods. [a] Depressive symptoms were defined as prevalence of Geriatrics Depression Scale ≥5 points. [b] Percentage of respondents that participated in the group.

From 2010 to 2016, the prevalence of depressive symptoms decreased and much of the health-related SC increased.

Table 2 shows the crude and adjusted model for the multiple regression of changes in health-related SC with changes in depressive symptoms. Among the 14 indicators of health-related SC, a significant association was observed for 10 indicators. For example, change in sports group (≤1 days/week: B, −0.356), change in frequency of contact with friends (≤1 days/month: B, −0.440), and change in reciprocity (B, −0.597) after adjusting to the change in socioeconomic status all predicted health-related SC.

Table 2. Multiple linear regression of changes in a health-related social capital (SC) with changes in depressive symptoms [b] (n = 44).

Variables	Crude			Model 1 [d]		
	B	SE	p Values	B	SE	p Values
% Change in [a] volunteer group (≥1 per month)	−0.273	0.184	0.145	−0.203	0.168	0.236
% Change in [a] sports group (≥1 per month)	−0.270	0.123	0.033	−0.234	0.124	0.066
% Change in [a] hobby group (≥1 per month)	−0.341	0.103	0.002	−0.309	0.111	0.008
% Change in [a] volunteer group (≥1 per week)	−0.089	0.230	0.700	0.051	0.224	0.822
% Change in [a] sports group (≥1 per week)	−0.397	0.152	0.013	−0.356	0.157	0.030
% Change in [a] hobby group (≥1 per week)	−0.215	0.134	0.115	−0.124	0.134	0.361
% Change in [a] frequency of contact with friends (≥1 per month)	−0.507	0.108	<0.001	−0.440	0.124	0.001
% Change in [a] receiving emotional social support	−0.797	0.276	0.006	−0.688	0.271	0.015
% Change in [a] providing emotional social support	−0.992	0.168	<0.001	−0.938	0.163	<0.001
% Change in [a] receiving instrumental social support	−0.229	0.321	0.479	−0.765	0.331	0.026
% Change in [a] providing instrumental social support	−0.451	0.227	0.054	−0.676	0.196	0.001
Change in [c] civic participation	−0.218	0.065	0.002	−0.189	0.068	0.008
Change in [c] social cohesion	−0.081	0.083	0.333	−0.171	0.074	0.027
Change in [c] reciprocity	−0.562	0.135	<0.001	−0.597	0.127	<0.001
% Change in [a] living alone	0.041	0.231	0.859			
% Change in [a] educational attainment	−0.252	0.071	0.001			
% Change in [a] equivalent income ≥2,000,000 JPY	−0.154	0.120	0.207			
% Change in [a] employed	−0.116	0.140	0.414			

All factors were adjusted for age using the direct methods. [a] Percentage of 2016 subtracted by 2010. [b] Depressive symptoms were defined as prevalence of Geriatrics Depression Scale ≥5 points. [c] The value of 2016 subtracted by 2010. [d] Model 1 was adjusted for change in living alone, change in educational attainment (≥10), change in equivalent income (≥2,000,000 JPY) and change in employed.

An association was shown between increased health-related SC and decreases in the prevalence of depressive symptoms after adjustment for potential confounding variables.

Supplementary Table S1 shows health-related SC for a 5-year change based on the sampling methods used. In the municipal units where the complete enumeration survey was carried out and a group with some oversampling was observed, we confirmed whether the change in the value from 2010 to 2016 was different in the two groups. Of the variables used as the dependent variable and independent variables, only change in social cohesion showed a difference between the two groups. In the case of a change in social cohesion, we performed multiple regression analysis and added the sampling methods' difference as dummy variables to adjust for the variables. However, the results did not change.

4. Discussion

According to our review of the literature, this is the first study to use a repeated cross-sectional design to verify that increases in the municipal unit level of health-related SC, such as civic participation, social cohesion, and reciprocity, are related to decreases in the prevalence of depressive symptoms in the municipal unit level.

Our results demonstrate that the prevalence of depressive symptoms after 5 years decreased by an average of 7.3% points. Another study reported a secular trend in the average score of GDS using the complete enumeration survey in the same district of older adults. According to the results,

the average score gradually decreased for men and women from 2003 to 2012 (GDS score annual average decrease value: men—0.001, women—0.09) and decreased significantly in women, and the reason for improvement was the influence of disability prevention project [31]. Furthermore, depression is a risk factor for suicide [7], and the suicide rate declined from 2010 to 2016 in Japanese older adults [32]. Therefore, there is a strong possibility that the prevalence of depressive symptoms is decreasing nationwide in Japan. The results of this study support these reports.

The health-related SC increased with many indicators from 2010 to 2016. According to previous studies, a secular trend is found for the index of Social Interaction using the complete enumeration survey in the same district of older adults [33]. According to that study, even though the interest in health-related SC increased over the last 20 years, SC in the form of social participation and social support did not change over those 20 years. One reason for the increase from 2010 to 2016 in this study could be the influence of Japanese disability prevention projects.

Since 2015, the disability prevention project in Japan has undergone a major policy change from a high-risk approach to a population strategy [34]. Disability prevention activities focusing on participation in activities are being promoted as one of the action policies. According to the records of the Ministry of Health, Labor and Welfare [35], places where older people can easily be active and participate increased from 43,154 in 2013 to 76,492 in 2016, which is, 1.77 times in 3 years. Notably, the number of people participating has also increased, from 840,718 in 2013 to 1,439,910 in 2016, which is, 1.71 times in 3 years. However, these numbers likely underestimate the actual numbers because they are merely the numbers captured by the municipality, not the total numbers. In addition, older people participate in activities such as sports and hobby groups in private clubs, but municipal units are unaware of the participants' presence. Thus, the number of participants is increasing even in places where the municipality does not comprehend; hence, the number of participants that actually exist is expected to be higher.

The JAGES provided evidence for this policy change [19], and the collaborating municipal units are eager to consider this effort. The increase in the number of places where older people can easily be active and participate will lead to an increase in older people who engage in activities and participation, and this increase in people's connections may have led to the increase in health-related SC from 2010 to 2016.

By considering the association between SC type and change in depressive symptoms, we showed an association between the decrease in depressive symptoms for increases in structural SC and cognitive SC. Regarding the structural SC, social participation and frequency of contact with friends were extracted from this factor. In the systematic review, the structural SC of the area was not related to CMD [9], whereas a structural SC, such as a sports group, a hobby group, and civic participation, showed a decrease in depressive symptoms in the current study.

In another study of JAGES, structural SC was divided into vertical and horizontal categories based on the result of factor analysis [36]. In vertical organizations, authority and resources are related hierarchically, whereas these two concepts are related equally in horizontal organizations. In relation to depression, a study demonstrated that the prevalence of depressive symptoms was low in areas where a high percentage of horizontal organizations, such as sports groups, adjusted individuals' participation in a cross-sectional manner [10]. In longitudinal studies, older people living in districts rich in horizontal organization have reported few depressive onsets 3 years later [11].

In this study, structural SC may be related to the decrease in depressive symptoms because it deals with the horizontal structure through the structural SC. Social networks, such as the frequency of contact with friends, are known to affect health through psychosocial mechanisms. Regarding connection and mental health, happiness as a network phenomenon that extends up to three degrees of separation was reported (e.g., to the friends of one's friends' friends) [37].

For cognitive SC, an association was observed between an increase in social cohesion and reciprocity and a decrease in the prevalence of depressive symptoms. Another study reported that community-level cognitive SC and CMD are inversely associated [9]. By contrast, longitudinal research

suggested that social cohesion and reciprocity at the community level were not associated with the onset of depression after 3 years [11]. As this study verified the association between change in health-related SC and change in depressive symptoms, the differences in the study designs might explain the different results. Further research is necessary.

These known mechanisms for community-level SC, namely (1) social contagion, (2) informal social control, and (3) collective efficacy, are the mechanisms that affect individual health [12]. In addition to those mechanisms, people's connections may have formed a network of social support and reduced the prevalence of depressive symptoms. Regarding the relationship between people's connections and depressive symptoms, a low prevalence of depressive symptoms in a community with high social support was reported [38]. A meta-analysis suggested that nonprofessional support is effective for reducing depressive symptoms [39], and it supported the association of community social support with depression. Due to the increase in municipal units' level of health-related SC, the prevalence of municipal units' level of depressive symptoms may decrease through the aforementioned route.

5. Strengths and Limitations

This research has two strengths. The first strength is that the prevalence of depressive symptoms decreased, whereas health-related SC increased. This result was based on a longitudinal study using a large population with a wide range of urbanites and 150,000 people in 44 municipal units with various characteristics. The second strength was that we verified the validity of a core indicator of an age-friendly city.

The results of this research may contribute to core indicators of socioenvironmental factors of an age-friendly city, which engages itself in volunteer and sociocultural activities recommended by the World Health Organization [40]. In Japan, after 2015, disability prevention focused on community development. This critical study suggests that increases in health-related SC, due to community development, may lead to decreases community-level depressive symptoms.

This research has three limitations. First, the target area of this study was 44 municipal units, which means that we could not verify the independence of each health-related SC, and there is a possibility that many factors could not be fully adjusted. However, we took advantage of the change between two time points, which may have controlled for time-invariant unobserved and observed confounding community characteristics [30].

Second, the use of repeated cross-sectional studies meant that we could not deny the possibility of reverse causality, such that increases in SC could have occurred as a result of decreases in depression. Other studies have demonstrated that the intervention promoting social participation in a community center increase health-related SC [16,17]. In Japan, the shift in the disability prevention measures allows the possibility that social participation in older adults is promoted by the increase in the number of places where older people can easily be active and participate, which can increase health-related SC.

6. Conclusions

We indicated that increases in municipality-level health-related SC factors, such as civic participation, social cohesion, and reciprocity, were related to decreases in municipality-level depressive symptoms using a 5-year repeated cross-sectional design, adjusting covariates. Our findings suggest that community SC interventions may reduce depressive symptoms in municipal units.

Supplementary Materials: The following are available online at http://www.mdpi.com/1660-4601/16/11/2038/s1, Table S1: Health-related social capital (SC) 5-year change by using sampling methods.

Author Contributions: All the authors contributed to the conception, design, and interpretation of data. R.W. performed the statistical analysis and drafted the manuscript. K.K. collected the data. K.K., T.S., T.T. (Taishi Tsuji), T.H., T.I. and T.T. (Tokunori Takeda) edited the manuscript and all authors approved the final version of the manuscript.

Funding: This study used data from JAGES (the Japan Gerontological Evaluation Study), which was supported by MEXT (Ministry of Education, Culture, Sports, Science and Technology-Japan)-Supported

Program for the Strategic Research Foundation at Private Universities (2009–2013), JSPS(Japan Society for the Promotion of Science) KAKENHI Grant Numbers (JP18390200, JP22330172, JP22390400, JP23243070, JP23590786, JP23790710, JP24390469, JP24530698, JP24683018, JP25253052, JP25870573, JP25870881, JP26285138, JP26882010, JP15H01972), Health Labour Sciences Research Grants (H22-Choju-Shitei-008, H24-Junkanki [Seishu]-Ippan-007, H24-Chikyukibo-Ippan-009, H24-Choju-Wakate-009, H25-Kenki-Wakate-015, H25-Choju-Ippan-003, H26-Irryo-Shitei-003 [Fukkou], H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001, H28-choju-Ippan-002, H30-Kenki-Ippan-006, H30-Junkankitou-Ippan-004), Japan Agency for Medical Research and Development (AMED) (171s0110002, 18le0110009, JP19dk0110034), the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29-42), World Health Organization Centre for Health Development (WHO Kobe Centre) (WHO APW 2017/713981). The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations.

Acknowledgments: We are grateful to 300BM members for helpful discussions.

Conflicts of Interest: The authors declare no conflict of interest.

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Preventive Medicine Reports 18 (2020) 101065

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Association between childhood socioeconomic position and sports group participation among Japanese older adults: A cross-sectional study from the JAGES 2010 survey

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ARTICLE INFO

Keywords:
Childhood disadvantage
Sports participation
Education
Older people
Life course

ABSTRACT

Sports group participation may have greater effects on health outcomes than exercising alone. Unhealthy lifestyles were reported to be specifically associated with lower socioeconomic positions (SEPs), and child poverty and the bipolarization of sports participation are currently major policy concerns in children. However, it remains unclear whether childhood SEP has any long-latency effect on sports group participation among older Japanese. Data were obtained from the Japan Gerontological Evaluation Study 2010 project, which used self-report questionnaires to survey individuals aged ≥65 years without disability from 27 municipalities (n = 23,320). According to their answers, respondents were assigned to one of three SEP groups: high, middle, or low. Poisson regression with robust variance and multiple imputations was used to examine the association between childhood SEP and sports group participation. After adjusting for health-related factors, low childhood SEP was negatively associated with sports group participation in men (prevalence ratio [PR] = 0.82, 95% confidence interval [CI] = 0.74–0.91) and women (PR = 0.88, 95% CI = 0.80–0.97). The PR was greatly attenuated after adjusting for educational attainment in both men (PR = 0.92, 95% CI = 0.83–1.02) and women (PR = 0.98, 95% CI = 0.89–1.08), and the significant association disappeared. Low childhood SEP is thus associated with lower sports group participation among older Japanese, though this may be attenuated by education. These findings suggest that it may be necessary to consider childhood SEP and the importance of education to increase sports group participation at an older age.

1. Introduction

Childhood socioeconomic position (SEP) are powerful predictors of health outcomes such as cardiovascular mortality, all-cause mortality (Cohen et al., 2010), and others (Galobardes et al., 2008; Rocha et al., 2019; Tamayo et al., 2010). Thus, since socioeconomic inequalities in childhood health have multiple adverse health consequences in later life, tackling these inequalities is an important public policy goal. Unhealthy lifestyles are reported to be correlated to a lower SEP (Foster et al., 2018). Several systematic reviews suggest that childhood SEP is an important determinant of later physical activity (PA) in adulthood (Elhakeem et al., 2015; Juneau et al., 2015). However, as there are fewer studies on older adults, it is not still completely understood whether childhood SEP contributes to later PA in old age.

The health benefits of PA for people of all ages are widely established (Lee et al., 2012; World Health Organization, 2018). In particular, sports group participation includes not only physiological benefits through increased PA but also psychological and social benefits through social participation beyond improvements attributed to individual types of PA (Eime et al., 2013; Farrance et al., 2016). A large

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https://doi.org/10.1016/j.pmedr.2020.101065
Received 15 April 2019; Received in revised form 28 January 2020; Accepted 8 February 2020
Available online 17 February 2020

cohort study of Japanese older adults showed that people who participated in sports groups showed a greater likelihood of avoiding functional disability than those who exercised alone (Kanamori et al., 2012), and that increasing the frequency of sports group participation alleviates worsening depressive symptoms compared with increasing daily walking time (Tsuji et al., 2017). In addition, another longitudinal study revealed that exercising with others has a more positive impact on mental well-being than exercising alone (Harada et al., 2019). Moreover, randomized controlled trials showed that social relations in exercise programs improved loneliness in older adults (Ehlers et al., 2017). This growing evidence suggests the possibility that sports group participation has a greater effect on health than PA alone, such as walking.

Understanding the association of childhood SEP with sports group participation among older adults may provide important insights into the pathways through which socioeconomic inequalities lead to lifelong adverse health consequences. It is particularly meaningful to examine this association among the Japanese people with a high relative child poverty rate (one in seven) (Ministry of Health, Labour and Welfare, 2018; OECD, 2019), along with the ongoing bipolarization of sports participation (Sasakawa Sports Foundation, 2015). However, most previous studies were based on American or European populations and have shown the association with PA, and no studies have examined whether childhood SEP later contributes to sports group participation among older Japanese adults. Therefore, this study aimed to examine the association between childhood SEP and sports group participation among Japanese older adults.

2. Methods

2.1. Study participants

This study utilized data from the Japan Gerontological Evaluation Study (JAGES) (Kondo and Rosenberg, 2018). The JAGES was established in 2010 to evaluate the social determinants of healthy aging among non-disabled people aged 65 or above, sampled from 31 municipalities in 12 of the 47 prefectures throughout Japan. From August 2010 to January 2012, a self-administered questionnaire was mailed to 169,215 community-dwelling individuals aged 65 or above who were physically and cognitively independent and living independently. Random sampling was used in the 16 large municipalities, while the questionnaire was sent to all eligible residents in the 15 small municipalities. Of the eligible participants, 112,123 returned the questionnaire (66.3% response rate) (Fig. 1). The JAGES questionnaire consisted of basic questions to be answered by all respondents, as well as five separate modules that were randomly allocated to participants (20% probability for each module). Of these, one data module, which included items related to childhood SEP (23,320 respondents; 10,657 men and 12,663 women), was used in this study. In this cross-sectional study, the analysis included 22,311 participants (10,276 men and 12,035 women) after excluding participants who reported limitations in activities of daily living (n = 1,009), defined as being unable to walk, take a bath, or use the toilet without assistance, and who were mistakenly included in the study (Fig. 1). The JAGES protocol was reviewed and approved by the Ethics Committee on Research of Human Subjects at Nihon Fukushi University (Approval No. 10–05). Written informed consent was assumed from the voluntary return of the questionnaire.

2.2. Participation in sports groups

This was assessed using the following question: "How often do you participate in a sports group or club?" Those who answered, "almost every day," "2 or 3 times a week," "once a week," "once or twice a month," "a few times a year," and "never." To examine the differences between people who have never been interested in sports group participation and those who have participated in sports groups, the participants were classified into two groups: "Non-participants (never)" and "Participants (other than never)," in accordance with a previous study (Ashida et al., 2016). Sports group participation included participation in not only team sports, but also sports organizations.

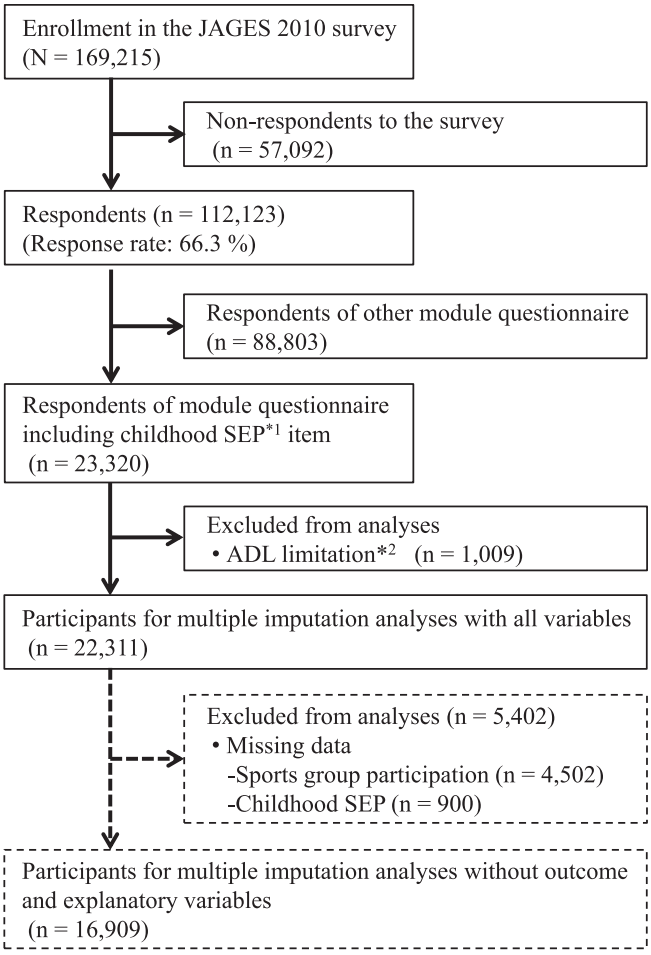

Fig. 1. Flow chart of participant selection in the Japan Gerontological Evaluation Study (JAGES) 2010 survey. *1 SEP: socioeconomic position. *2 ADL: activities of daily living.

2.3. Childhood SEP

This was retrospectively assessed by recalled subjective SEP using the following question: "How would you rate your socioeconomic status at the age of 15 years according to standards at that time?" Responses were arranged on a five-point Likert scale: "high," "middle-high," "middle," "middle-low," and "low." These responses were allocated to three categories: high (including "high" and "middle-high"), middle, and low (including "middle-low" and "low") to maximize the sample size for each category. This method has previously been validated using siblings' data (Ward, 2011). Moreover, recalled subjective SEP in childhood has shown a good correlation with adult height (as a proxy for childhood nutrition) and/or homeownership (Fujiwara et al., 2014; Tani et al., 2016; Yanagi et al., 2017).

2.4. Covariates

Based on previous studies (Kanamori et al., 2012; Tani et al., 2016; Yamakita et al., 2015; Yanagi et al., 2017), the following variables were used as covariates. As health-related factors, age (continuous variables), current medical treatment (yes/no), instrumental activities of daily

living (IADL), self-rated health, depression, body mass index (BMI), smoking status (non-smoker, ex-smoker, current smoker), alcohol intake (non-drinker, ex-drinker, or current drinker), marital status (married, widowed, divorced, single), providing emotional social support (yes/no), and receiving emotional social support (yes/no) were included. IADL was assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence ("good" [5 points] or "poor" [0–4 points]) (Koyano et al., 1991). Self-rated health is a subjective indicator that reflects the overall health status. In this study, we evaluated this indicator by asking the following question: "How is your current health status?" The possible responses were "excellent," "good," "fair," and "poor." Depression was measured using the short version of the Geriatric Depression Scale–15 (Japanese version) and was categorized into three groups ("no" [0–4 points], "mild" [5–9 points], "moderate to severe" [10–15 points]) (Nyunt et al., 2009; Schreiner et al., 2003). Body mass index (BMI) was calculated from self-reported height and weight (kg/m^2).

2.5. Mediators

According to a previous study, height (Fujiwara et al., 2014), educational attainment (Frenz et al., 2017; Galobardes et al., 2008; Lawlor et al., 2006), and adulthood SEP (Cheval et al., 2018; Umeda et al., 2015) were used as potential mediators. These variables were assessed from the self-reported questionnaire. Height was used as a proxy for the childhood nutritional environment and disease history (Silventoinen, 2003), and was categorized into five groups at 5 cm intervals for each sex, as shown in Tables 1-3. Previous studies confirmed a high correlation between self-reported and measured height among older people in Australia (Ng et al., 2011). Educational attainment was assessed categorized into three groups by years of schooling (<10, 10–12, ≥13 years). As indicators of adulthood SEP, current annual household income, which reflects SEP in old-age, and longest-held occupation, which reflects SEP in middle-age, were included. Annual household income was calculated by dividing household income by the square root of the number of household members and categorized into three groups (<2.00, 2.00–3.99, ≥4.00 million yen). Since previous studies have confirmed that the Japanese managerial/professional class appears to potentially experience a higher CHD risk compared to other occupations (Zaitsu et al., 2019), longest-held occupations were categorized into three groups: non-manual occupations (professional, technical, managerial work), manual occupations (clerical, sales/service, skilled/labor or agriculture/forestry/fishery worker, other), and no occupation (Tani et al., 2016).

2.6. Statistical analysis

Because sex has been shown to influence the relationship between childhood SEP and physical inactivity (Cheval et al., 2018)—and because, as noted by Hawkes et al. (2013), disaggregation by sex is essential in health research—sex was controlled by conducting stratified analysis.

To account for potential biases due to missing values, we conducted multiple imputation analyses with 22,311 study participants, who experienced no limitations in activities of daily living. Following Sterne et al. (2009), all variables included in the analysis, such as the outcome variables, explanatory variables, and covariates, were imputed. Table 1 and Supplementary Table 1 presents the number of participants for whom data was imputed (because of missing values). Under a missing-at-random assumption, we created 20 imputed data using a chained equation procedure (White et al., 2011). The estimated parameters were combined using Rubin's combination method (Rubin, 1987). Poisson regression with robust variance was used to examine the association between childhood SEP and sports group participation due to the relatively high prevalence of the latter (>10%): in such cases, odds ratios obtained from logistic regression models can significantly overestimate prevalence ratios (Barros and Hirakata, 2003; McNutt et al., 2003).

Table 1
Characteristics of participants of the Japan Gerontological Evaluation Study (JAGES) 2010 survey (n = 22,311).

	Men (n = 10,276)		Women (n = 12,035)	
	n	(%)	n	(%)
Participation in sport group				
Participants	2,450	(23.8)	2,513	(20.9)
Almost every day	228	(2.2)	182	(1.5)
2 or 3 times a week	647	(6.3)	923	(7.7)
Once a week	497	(4.8)	811	(6.7)
Once or twice a month	474	(4.6)	347	(2.9)
A few times a year	604	(5.9)	250	(2.1)
Non-participants (Never)	6,084	(59.2)	6,762	(56.2)
Missing	1,742	(17.0)	2,760	(22.9)
Childhood SEP				
High (high or middle-high)	937	(9.1)	1,942	(16.1)
Middle	3,740	(36.4)	5,155	(42.8)
Low (middle-low or low)	5,057	(49.2)	4,173	(34.7)
Missing	542	(5.3)	765	(6.4)
Height*				
Tall	1,460	(14.2)	553	(4.6)
Middle-tall	2,687	(26.2)	2,051	(17.0)
Middle	3,292	(32.0)	3,986	(33.1)
Middle-short	1,745	(17.0)	3,394	(28.2)
Short	846	(8.2)	1,517	(12.6)
Missing	246	(2.4)	534	(4.4)
Educational level (years)				
≥13	2,250	(21.9)	1,472	(12.2)
10–12	3,365	(32.8)	4,324	(35.9)
<10	4,481	(43.6)	5,883	(48.9)
Missing	180	(1.8)	356	(3.0)
Annual equivalized income (yen)				
≥4.00 million	1,064	(10.4)	1,005	(8.4)
2.00–3.99 million	3,630	(35.3)	3,401	(28.3)
<2.00 million	4,272	(41.6)	4,820	(40.0)
Missing	1,310	(12.8)	2,809	(23.3)
Longest-held occupation				
Non-manual	3,367	(32.8)	1,099	(9.1)
Manual	5,905	(57.5)	7,473	(62.1)
None	54	(0.5)	1,061	(8.8)
Missing	950	(9.2)	2,402	(20.0)

SEP: socioeconomic position.
*Height in cm (men, women): tall (≥170, ≥160), middle-tall (165–169.9, 155–159.9), middle (160–164.9, 150–154.9), middle-short (155–159.9, 145–149.9), short (<155, <145).

Model 1 was first adjusted for health-related factors (age, current medical treatment, IADL, self-rated health, depression, BMI, smoking status, alcohol intake, marital status, providing or receiving emotional social support). Next, Model 2 added height as a childhood circumstance to investigate how much it changes the association. In addition, since several studies indicated that educational attainment resulted in attenuation of the associations between low childhood SEP and adverse health outcomes later in life (Frenz et al., 2017; Galobardes et al., 2008; Lawlor et al., 2006), educational attainment was further adjusted in Model 3 to examine whether it influences these associations. Additionally, adulthood SEP (annual equivalized income and longest-held occupations) was added to Model 3 to investigate the effect on participants of all SEP (Model 4).

For sensitivity analyses (as a complete case analysis), different multiple imputation analyses were performed for participants, which excluded the missing values for sports group participation (outcome) and childhood SEP (explanatory) variables (Supplementary Tables 2 and 3). In addition, sensitivity analyses with the cut-off setting of "once or twice a month" for sports group participation were performed (Supplementary Tables 4 and 5). All statistical analyses and multiple imputations were performed using Stata/SE version 15.1 (StataCorp

Table 2
Adjusted prevalence ratio with 95% CI for association of childhood SEP with participation in sports groups in older Japanese men in the Japan Gerontological Evaluation Study (JAGES) 2010 survey with all variable multiple imputations (n = 10,276).

	Model 1 PR (95% CI)	p	Model 2 PR (95% CI)	p	Model 3 PR (95% CI)	p	Model 4 PR (95% CI)	p
Childhood SEP								
High	Reference		Reference		Reference		Reference	
Middle	0.93 (0.84–1.02)	0.136	0.93 (0.84–1.03)	0.175	0.98 (0.89–1.09)	0.714	0.99 (0.89–1.09)	0.826
Low	0.82 (0.74–0.91)	<0.001	0.83 (0.75–0.92)	<0.001	0.92 (0.83–1.02)	0.120	0.93 (0.84–1.04)	0.191
Height								
Tall			Reference		Reference		Reference	
Middle-tall			1.00 (0.92–1.11)	0.849	1.03 (0.93–1.13)	0.596	1.04 (0.94–1.14)	0.469
Middle			0.93 (0.84–1.02)	0.127	0.96 (0.87–1.06)	0.390	0.98 (0.89–1.07)	0.620
Middle-short			0.90 (0.80–1.01)	0.076	0.95 (0.85–1.07)	0.428	0.98 (0.87–1.10)	0.689
Short			0.81 (0.69–0.95)	0.010	0.87 (0.75–1.02)	0.094	0.91 (0.77–1.06)	0.223
Education (years)								
≥13					Reference		Reference	
10–12					0.90 (0.83–0.97)	0.005	0.93 (0.86–1.01)	0.083
<10					0.70 (0.64–0.76)	<0.001	0.75 (0.69–0.82)	<0.001
Annual equivalized income								
≥4.00 million yen							Reference	
2.00–3.99 million yen							0.94 (0.86–1.04)	0.225
<2.00 million yen							0.86 (0.78–0.95)	0.003
Longest-held occupation								
Non-manual							Reference	
Manual							0.86 (0.80–0.92)	<0.001
None							0.69 (0.36–1.33)	0.267

SEP: socioeconomic position; PR: prevalence ratio; CI: confidence interval.
Model 1: Adjusted for health-related factors (age, medication, instrumental activities of daily living, self-rated health, depression, body mass index, smoking status, alcohol intake, marital status, and social support).
Model 2: Model 1 + height.
Model 3: Model 2 + education.
Model 4: Model 3 + adulthood SEP (annual equivalized income, longest-held occupation).

Table 3
Adjusted prevalence ratio with 95% CI for association of childhood SEP with participation in sports groups in older Japanese women in the Japan Gerontological Evaluation Study (JAGES) 2010 survey with all variable multiple imputations (n = 12,035).

	Model 1 PR (95% CI)	p	Model 2 PR (95% CI)	p	Model 3 PR (95% CI)	p	Model 4 PR (95% CI)	p
Childhood SEP								
High	Reference		Reference		Reference		Reference	
Middle	0.98 (0.90–1.07)	0.668	0.99 (0.91–1.08)	0.785	1.04 (0.95–1.13)	0.433	1.03 (0.95–1.12)	0.485
Low	0.88 (0.80–0.97)	0.011	0.90 (0.82–0.99)	0.025	0.98 (0.89–1.08)	0.724	0.98 (0.89–1.08)	0.674
Height								
Tall			Reference		Reference		Reference	
Middle-tall			1.11 (0.95–1.29)	0.205	1.12 (0.96–1.31)	0.150	1.12 (0.96–1.31)	0.154
Middle			1.01 (0.87–1.18)	0.837	1.04 (0.89–1.21)	0.608	1.04 (0.89–1.21)	0.624
Middle-short			0.99 (0.85–1.16)	0.906	1.03 (0.88–1.20)	0.717	1.03 (0.88–1.21)	0.693
Short			0.85 (0.71–1.03)	0.091	0.90 (0.75–1.08)	0.242	0.90 (0.75–1.09)	0.280
Education (years)								
≥13					Reference		Reference	
10–12					0.91 (0.84–0.99)	0.032	0.92 (0.84–1.00)	0.057
<10					0.74 (0.68–0.82)	<0.001	0.77 (0.69–0.85)	<0.001
Annual equivalized income								
≥4.00 million yen							Reference	
2.00–3.99 million yen							1.09 (0.97–1.22)	0.144
<2.00 million yen							0.96 (0.86–1.07)	0.495
Longest-held occupation								
Non-manual							Reference	
Manual							0.95 (0.86–1.05)	0.307
None							0.91 (0.79–1.04)	0.169

SEP: socioeconomic position; PR: prevalence ratio; CI: confidence interval.
Model 1: Adjusted for health-related factors (age, medication, instrumental activities of daily living, self-rated health, depression, body mass index, smoking status, alcohol intake, marital status, and social support).
Model 2: Model 1 + height.
Model 3: Model 2 + education.
Model 4: Model 3 + adulthood SEP (annual equivalized income, longest-held occupation).

LLC, College Station, TX, USA) with statistical significance inferred at a two-tailed p-value of <0.05.

3. Results

Among all participants including missing values, 22.2% were sports group participants (Table 1), and 49.2% of men and 34.7% of women reported low or middle-low SEP in childhood, while 9.1% of men and 16.1% of women reported high or middle-high childhood SEP. Among men, the percentages for 13 or more years' educational attainment and non-manual occupation were higher than among women.

The sociodemographic and health characteristics of the participants are shown in Supplemental Table 1. The mean age (standard deviation) was 73.9 (6.1) years (ranging from 65 to 101 years); 46.1% were men. Among men, being married was higher than among women. By contrast, compared to men, more women were non-smokers, non-drinkers, and had good IADL.

Table 2 shows the association between childhood SEP and the prevalence ratio (PR) of sports group participation in older men. Compared with the high childhood SEP group, the PR of sports group participation was 7% lower in the middle childhood SEP group and 18% lower in the low childhood SEP group in the health-related factors-adjusted model (Model 1). When analyses were controlled for height, the point estimates of PR for participation in sports groups were very slightly attenuated (Model 2). However, when analyses were controlled for educational attainment, the PR in the childhood SEP group was greatly attenuated (PR = 0.92, Model 3), and statistical significance disappeared. This association was very slightly attenuated in the low childhood SEP group after adjusting for adulthood SEP (Model 4).

When analyses were controlled for height, the point estimates of PR for participation in sports groups were slightly attenuated, although statistical significance remained the same (Model 2).

Among women, compared with the high childhood SEP group, the PR of sports group participation was 12% lower in the low childhood SEP group in the health-related factors-adjusted model (Model 1 in Table 3). When analyses were controlled for height, the point estimates of PR for participation in sports groups were slightly attenuated, although statistical significance remained the same (Model 2). However, when analyses were controlled for educational attainment, this association was no longer statistically significant (PR = 0.98, Model 3 in Table 3). The association was almost unchanged after adjusting for adulthood SEP (Model 4 in Table 3).

The sensitivity analysis that excluded the missing values for sports group participation and childhood SEP variables exhibited similar results with slightly smaller PRs (Supplemental Tables 2 and 3). The sensitivity analyses with the cut-off setting of "once or twice a month" revealed that the point estimates of PR exhibited similar results with a cut-off setting of "participants or non-participants" among men and women (Supplemental Tables 4 and 5).

4. Discussion

This study investigated the association between childhood SEP and sports group participation in older adults. Its results demonstrate that low childhood SEP is associated with lower sports group participation in older men, even after adjusting for health-related factors. After adjustment for educational attainment, the PR in the low childhood SEP group was both greatly attenuated and more attenuated than when adjusted for any other health-related or social characteristic in adulthood. This suggests that education may possibly shrink differences in the association between childhood SEP and sports group participation among older adults.

Despite inconsistencies in the results, prior evidence suggests that low childhood SEP groups participate less frequently in leisure-time PA in adulthood and early old age compared with high childhood SEP groups (Elhakeem et al., 2015, 2017). Consistent with these studies, our study of older adults found that lower childhood SEP groups were less likely to participate in sports groups. While both men and women showed similar results, PR was consistently lower for men than women. One possible explanation is a sex difference in the tracking of PA from childhood to adulthood. Several previous studies have reported that men show greater stability in tracking PA compared to women in all phases of the life course (Telama et al., 2014). This difference is supported by findings that many life events, such as pregnancy, getting married, or having small children, have a greater influence on the PA of women than on that of men (Allender et al., 2008; Engberg et al., 2012; Telama et al., 2014). In addition, it has been suggested that men are more likely to participate in PA than women in childhood (World Health Organization, 2018), and also that men from lower SEP groups are more likely than women to engage in risky health behaviors, such as smoking, an unhealthy diet, and physical inactivity (Lawlor et al., 2006), which may be further explanations for the sex difference.

Our findings demonstrate that educational attainment has a stronger effect than other factors in attenuating the association of low childhood SEP with lower sports group participation in older adults. Our findings showed that the PR for participation in sports groups remained almost unchanged after adjusting for height, a variable often utilized as a proxy for childhood nutrition. In contrast, after adjusting for educational attainment, the PR in the low childhood SEP group was greatly attenuated. This is consistent with many previous studies (Elhakeem et al., 2015; Gidlow et al., 2006). Education is completed early in the life course and associated with subsequent income, employment, social networks, and behaviors (Byhoff et al., 2017). Moreover, educational attainment is associated with numerous mental and physical health outcomes (Byhoff et al., 2017; Kubota et al., 2017; Ladin, 2008; Xu et al., 2016). Furthermore, those who achieve higher educational attainment might have pursued a healthy lifestyle regardless of their personal income changes (Montez and Friedman, 2015). Our findings support the importance of education in explaining the link between childhood SEP and PA in adulthood (Elhakeem et al., 2015), and show that education also explains the link between childhood SEP and sports group participation in older adults. In the model, after adjusting for adulthood SEP, the PR remained almost unchanged. This suggest that education more strongly mediates the association between childhood SEP and sports group participation in adulthood than adulthood SEP. Thus, although education mediates the association between childhood SEP later-life sports participation, further study is called for to examine the indirect effects mediating educational attainment.

The mechanisms that explain the association between childhood SEP and later-life sports participation are not fully understood. However, given the similarity of the association between childhood SEP and PA (Elhakeem et al., 2015), educational attainment that increases health literacy may be one possible pathway (Montez and Friedman, 2015). Lower childhood SEP tends to restrict future SEP (Byhoff et al., 2017), as mentioned above. Another pathway may be the tracking of PA. Numerous studies consistently show that children from families with low SEP participate less in sports groups compared to high- SEP children (Stalsberg & Pedersen, 2010), and participation in PA and sports in childhood tends to be maintained throughout adulthood (Cleland et al., 2012; Telama et al., 2014) and thus old age. For these reasons, intervention to enhance educational attainment and promote sports in childhood may be an effective investment to increase sports group participation in future older adults. These childhood investments may lead to extending healthy life expectancy in the future. Additional studies conducting a mediation analysis are needed in order to demonstrate these associations and clarify the mechanism driving childhood SEP and sports group participation later in life.

4.1. Strengths and lsimitations

This study's strengths include the large sample, comprising older

adults from across Japan, and the inclusion of a wide range of variables. To our knowledge, no prior study has investigated the association between childhood SEP and sports group participation in older adults. Our findings establish childhood SEP as a new factor associated with sports group participation among Japanese older adults.

However, several limitations of this study should be considered. First, childhood SEP was evaluated retrospectively due to the cross-sectional design and self-reported method and is therefore susceptible to recall bias and could not establish causality. However, previous studies have confirmed the validity of retrospectively evaluating subjective childhood SEP (Ward, 2011) and childhood neighborhood context (Osypuk et al., 2015). In addition, the childhood subjective SEP was found to correlate with other objective indicators, of deprivation, such as height and SEP achieved in adulthood (Sakurai et al., 2010). Further studies are needed to examine whether there is a similar association between objective childhood SEP and participation in sports groups in old age. Second, since all measures were self-reported and the health status of some items such as smoking status and alcohol intake did not have detailed information, it is possible that measurement error occurred. Third, for the sampling method, while randomization was used in urban areas, the questionnaire was given to all eligible residents in the rural areas due to the small number of residents. Fourth, the generalizability of the results requires attention since this study did not include older adults with long-term-care insurance. Finally, information on participation in PA and in sports groups, including intensity, frequency, and types, was lacking. It would be useful to understand the mechanisms whereby childhood SEP affects sports group participation in old age. Therefore, further robust studies, including participation in PA and sports group participation at the early life stage, are needed to clarify this association.

5. Conclusion

This study demonstrated that low childhood SEP is associated with lower participation in sports groups among older adults, although this association may be attenuated by education. Our study highlighted the importance of education and implementing policies to tackle child poverty in order to increase sports group participation across the life course.

CRediT authorship contribution statement

Mitsuya Yamakita: Conceptualization, Methodology, Formal analysis, Writing - original draft. **Satoru Kanamori:** Methodology, Investigation, Writing - review & editing. **Naoki Kondo:** Data curation, Formal analysis, Writing - review & editing, Supervision, Funding acquisition, Project administration. **Toyo Ashida:** Methodology, Writing - review & editing. **Takeo Fujiwara:** Investigation, Methodology, Writing - review & editing, Supervision. **Taishi Tsuji:** Data curation, Methodology, Formal analysis. **Katsunori Kondo:** Conceptualization, Methodology, Investigation, Writing - review & editing, Supervision, Funding acquisition, Project administration.

Acknowledgments

This study used data from JAGES (the Japan Gerontological Evaluation Study). This study was supported by MEXT (Ministry of Education, Culture, Sports, Science and Technology-Japan)-Supported Program for the Strategic Research Foundation at Private Universities (2009-2013), Grants-in-Aid for Scientific Research (18390200, 22330172, 22390400, 23243070, 23590786, 23790710, 24390469, 24530698, 24683018, 25253052, 25870573, 25870881, 26285138, 26882010, 15H01972, 15K03417, 17K01794, 17K19793, and 18H04071) from JSPS (Japan Society for the Promotion of Science), Health Labour Sciences Research Grants (H22-Choju-Shitei-008, H24-Junkanki [Seishu]- Ippan-007, H24-Chikyukibo-Ippan-009, H24-Choju-Wakate-009, H25-Kenki-Wakate-015, H25-Choju-Ippan-003, H26-Irryo-Shitei-003 [Fukkou], H26-Choju-Ippan-006, H27-Ninchisyou-Ippan-001, H28-choju-Ippan-002, H28- Ninchisyou-Ippan-002, H29-Chikyukibo-Ippan-001, H30- Kenki-Ippan-006, H30-Jyunkankitou-Ippan-004, 19FA1012, 19FA2001) from the Ministry of Health, Labour and Welfare, Japan, the Research and Development Grants for Longevity Science from Japan Agency for Medical Research and development (AMED) (JP171s0110002, JP18le0110009,JP17dk0110027, JP18dk0110027, JP18ls0110002, JP18le0110009, JP19dk0110034, JP19dk0110037), the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29-42, 30-30, 30-22), World Health Organization Centre for Health Development (WHO Kobe Centre) (WHO APW 2017/713981), Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST), a grant from the Japan Foundation For Aging And Health (J09KF00804), and the Yamanashi Research Grant for Young Scholars. The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the respective funding organizations. The funding sources had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The authors declare that they have no conflicts of interest. The results of this study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation.

Availability of data and materials

Data are from the JAGES project. All inquiries should be addressed to the data management committee via e-mail: dataadmin.ml@jages.net. All JAGES datasets have ethical or legal restrictions for public deposition due to the inclusion of sensitive information from human participants.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2020.101065.

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Int J Geriatr Psychiatry. 2019 Nov;34(11):1642-1650. doi: 10.1002/gps.5177. Epub 2019 Jul 26.

Socio-economic status and dementia onset among older Japanese: A 6-year prospective cohort study from the Japan Gerontological Evaluation Study.

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Abstract

OBJECTIVES:

Lower socio-economic status (SES) may be associated with dementia later in life, but there is inconsistent evidence supporting this claim. We aim to examine the association between three SESs (education, job, and income indicators) and dementia onset in older adults.

METHODS:

Study design was a 6-year prospective cohort study. Participants included a total of 52 063 community-dwelling adults aged 65 years or older without long-term care needs from the Japan Gerontological Evaluation Study. Outcome variable was dementia onset. Explanatory variables were educational years, the longest job held, and equivalised household income. We performed Cox proportional hazard analysis by gender with multiple imputation.

RESULTS:

During the follow-up period, 10.5% of participants acquired dementia. The adjusted risks of dementia incidence of the participants with less than 6 years of education were 1.34 times (95% confidence interval [CI], 1.04-1.73) in men and 1.21 (1.00-1.45) times in women higher than those with more than 13 years of education. Females with less than 1.99 million yen (hazard ratio = 0.83, 0.72-0.96) of equivalised income were less likely to acquire dementia than those with four million yen or higher.

CONCLUSIONS:

Educational attainment had a robust impact on dementia onset compared with the other SES factors in both genders of older Japanese people. Securing an education for children could be crucial to prevent dementia later in life. The longest job held was less likely to be risks of dementia incidence, compared with the other two factors.

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

神戸市における年代別の地域間健康格差の実態把握および格差が大きい指標の抽出

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研究要旨

本研究では、神戸市の 9 行政区間の健康格差の現状を年代ごとに記述（見える化）し、成人層（20～64 歳）と高齢層（65 歳以上）との間で格差が固定化されている地域・指標と、年代間で格差の様子が異なる地域・指標とをそれぞれ明らかにすることを第一の目的とした。また、成人層のデータを基に、行政区間の格差が大きい指標を抽出することを第二の目的とした。成人層は 6,584 人、高齢層は 10,040 人を分析対象とした。不利な状況が年代を越えて固定化されている地域・指標が見つかった一方、高齢層と比較して成人層で状況が好転している地域・指標や、逆に成人層で悪化している地域・指標も見つかった。例えば主観的健康感に着目すると、B 区の男性は年代を問わず不良者が多かったが、別の I 区では若年層でのみ、さらに別の H 区では高齢層ほど不良者が多いなど、地域と指標によって格差の様相は異なっていた。また、成人層の各年代に共通して格差が大きい指標として、独居者割合、低所得者割合、低学歴者割合、経済的に苦しい者の割合などの社会経済的な指標が確認された。このような現状を把握した上で、健康格差の是正に向けた中長期的な対策を検討することが肝要であろう。

A．研究目的

日本老年学的評価研究（Japan Gerontological Evaluation Study: JAGES）と神戸市が実施した郵送調査「健康とくらしの調査」により、成人層・高齢層のいずれの世代においても、地域間の健康格差の存在が確認されている。本研究では、神戸市の 9 行政区間の健康格差の現状を年代ごとに記述（見える化）し、成人層（20～64 歳）と高齢層（65 歳以上）との間で格差が固定化されている地域・指標と、年代間で格差の様子が異なる地域・指標とをそれぞれ明らかにすることを第一の目的とした。また、成人層のデータを基に、行政区間の格差が大きい指標を抽出することを第二の目的とした。

B．研究方法

1．対象者

成人層のデータは、2018 年に実施した健康とくらしの調査の回答者のうち、性、年齢、行政区の情報に欠損が無い者を分析対象とした。男・20～39 歳は 1,088 人、女・20～39 歳は 1,651 人、男・40～64 歳は 1,633 人、女・40～64 歳は 2,212 人であった。また、高齢層のデータは、2016 年に実施した健康とくらしの調査の回答者のうち、性、年齢、行政区の情報に欠損が無く、日常生活動作が自立した者を分析対象とした。男・65～74 歳は 2,622 人、女・65～74 歳は

2,983 人、男・75 歳以上は 2,036 人、女・75 歳以上は 2,399 人であった。

２．調査項目

目的 1（年代間の健康格差の比較）においては、成人層と高齢層の各調査の両方に含まれた項目から、下記に該当する割合を行政区ごとに算出した。

・主観的健康感（良い、まあ良い）
・1 年以内の健診受診（あり）
・現在の喫煙習慣（あり）
・ボランティアの会・グループ参加（月 1 回以上）
・スポーツの会・グループ参加（月 1 回以上）
・趣味の会・グループ参加（月 1 回以上）
・町内会・自治会への参加（月 1 回以上）
・友人・知人と会う頻度（月 1 回以上）
・地域の人々への信頼・信用
・地域の人々の助け合い・役に立とうとする
・幸福感（9 点、10 点）
・暮らしぶり（大変苦しい、やや苦しい）

目的 2（格差が大きい指標の抽出）においては、成人層の調査のうち、JAGES が提供している見える化ツール「地域マネジメント支援システム（https://www.jages.net/project/jagesheart/）」に搭載されている下記の指標から抽出を行った。

・独居者割合
・配偶者がいる者の割合
・未婚者割合
・孤食者割合
・低所得者割合
・低学歴者割合
・高校卒者割合
・大学卒者割合
・経済的に苦しい者の割合
・子どもの頃経済的に苦しかった者の割合
・主観的健康感が良い者の割合
・幸福感がある者の割合
・口腔機能低下者割合
・残歯数 19 本以下の者の割合
・残歯数 20 本以上の者の割合
・スポーツの会参加者(月 1 回以上)割合
・趣味の会参加者(月 1 回以上)割合

・ボランティア参加者(月 1 回以上)割合
・学習・教養サークル参加者(月 1 回以上)割合
・特技や経験を他者に伝える活動参加者(月 1 回以上)割合
・町内会参加者(月 1 回以上)割合
・週 1 回以上運動する人の割合
・運動を 1 年以上連続している人の割合
・仕事している人の割合
・常勤・正規職員者の割合
・自営業・家業者の割合
・就労していない者の割合
・休日勤務（5 日以上/月）者の割合
・深夜労働者の割合（5 日以上/月）
・残業している（20 時間以上/月）者の割合
・友人知人と会う頻度が高い(月 1 回以上)者の割合
・交流する友人（0～2 人）がいる者の割合
・交流する友人（3～9 人）がいる者の割合
・交流する友人（10 人以上）がいる者の割合
・地域活動の参加意向がある者の割合
・喫煙する者の割合
・5 年以上喫煙している者の割合
・飲酒者割合
・健診(1 年以内)未受診者割合
・1 年間に歯科検診を受けている者の割合

3．統計解析

目的 1（年代間の健康格差の比較）においては、男女別に 20～39 歳、40～64 歳、65～74 歳、75 歳以上の各年代層（すなわち 8 つの性・年代カテゴリ）で、各指標の該当割合を 9 つの行政区ごとに算出した。そして、該当者が少ないほど望ましい指標については該当割合が最も低い区が 1 位、逆に多いほど望ましい指標については該当割合が最も高い区が 1 位となるように、各指標について 1～9 位のランク付けを行った。

目的 2（格差が大きい指標の抽出）においては、20～39 歳、40～64 歳の各年代層で、各指標の該当割合を 9 つの行政区ごとに算出した後に、それらの平均値と標準偏差を基に偏差値に換算した。この偏差値が 30 未満、35 未満、70 以上となる行政区が生じた指標を抽出することで、格差が大きい指標を探索した。

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫

理・利益相反委員会で承認を受けて研究を行った。

C．研究結果

目的 1（年代間の健康格差の比較）について、結果の一覧を表 1-1～1-12 に示した。不利な状況が年代を越えて固定化されている地域・指標と、成人層では好転している、逆に悪化している地域・指標とがそれぞれ一定数見つかった。

例えば、不利な状況が固定化されている地域・指標としては、B 区男性の主観的健康感（表 1-1）、H 区男性のスポーツの会・グループ参加（表 1-5）、B 区女性の趣味の会・グループ参加（表 1-6）、A 区と B 区の男女の地域の人々への信頼（表 1-9）、B 区男性の地域の人々の助け合い（表 1-10）、B 区の男女の暮らしぶりが苦しい（表 1-12）、H 区女性の暮らしぶりが苦しい（表 1-12）などが確認された。

高齢層では悪いが成人層ではその状況を抜け出している地域・指標としては、H 区男女の主観的健康感（表 1-1）、B 区男性の健診受診（表 1-2）、B 区男性の喫煙習慣（表 1-3）、A 区と B 区の男女のスポーツの会・グループ参加（表 1-5）、B 区女性の地域の人々の助け合い（表 1-10）、B 区男女の暮らしぶりが苦しい（表 1-12）などが確認された。

一方、高齢層では良いが成人層では悪くなっている地域・指標としては、D 区女性の主観的健康感（表 1-1）や喫煙習慣（表 1-3）、趣味の会・グループ参加（表 1-6）、C 区男性のボランティアの会・グループ参加（表 1-4）や趣味の会・グループ参加（表 1-6）、C 区女性のスポーツの会・グループ参加（表 1-5）などが見られた。

表1-1. 主観的健康感（20–64歳: よい、まあよい［5件法］、65歳以上: とてもよい、まあよい［4件法］）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	59.4%	2	124	44.4%	3	185	88.6%	6	142	83.1%	5
B区	91	53.8%	7	104	37.5%	7	180	82.8%	8	174	79.3%	8
C区	131	58.8%	3	241	42.3%	4	427	90.6%	4	314	85.7%	2
D区	151	61.6%	1	241	35.3%	8	374	90.9%	3	372	87.1%	1
E区	160	58.8%	4	250	46.4%	2	346	86.4%	7	270	85.2%	4
F区	82	52.4%	9	138	50.0%	1	198	91.9%	2	164	81.7%	7
G区	201	55.2%	6	259	38.6%	6	415	92.0%	1	219	82.2%	6
H区	59	57.6%	5	91	24.2%	9	186	80.1%	9	153	77.8%	9
I区	107	53.3%	8	185	38.9%	5	311	88.7%	5	228	85.5%	3
Total	1,088	57.1%		1,633	40.4%		2,622	88.8%		2,036	83.8%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	58.7%	4	155	50.3%	2	218	89.9%	9	199	86.4%	5
B区	100	54.0%	9	144	31.9%	8	201	91.5%	2	246	85.8%	7
C区	222	58.6%	5	302	39.7%	5	443	91.4%	3	299	91.3%	1
D区	254	55.5%	8	336	44.3%	4	479	91.9%	1	357	88.5%	3
E区	244	64.8%	1	337	51.3%	1	397	90.9%	5	349	84.8%	8
F区	160	60.0%	2	221	45.7%	3	230	91.3%	4	250	86.0%	6
G区	263	55.9%	7	389	39.3%	6	435	90.6%	7	230	90.9%	2
H区	80	57.5%	6	118	32.2%	7	203	90.1%	8	210	80.5%	9
I区	149	59.7%	3	210	31.4%	9	377	90.7%	6	259	88.4%	4
Total	1,651	58.5%		2,212	41.8%		2,983	91.0%		2,399	87.1%	

表1-2. 過去1年以内の健診受診（あり）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	83.0%	3	124	81.5%	8	185	62.7%	6	142	47.2%	5
B区	91	79.1%	5	104	77.9%	9	180	48.9%	9	174	42.0%	9
C区	131	77.1%	7	241	90.0%	3	427	60.7%	8	314	48.4%	3
D区	151	85.4%	1	241	88.4%	4	374	63.9%	4	372	50.0%	1
E区	160	79.4%	4	250	87.6%	5	346	67.9%	2	270	49.3%	2
F区	82	78.0%	6	138	90.6%	2	198	67.7%	3	164	44.5%	7
G区	201	83.1%	2	259	91.1%	1	415	68.0%	1	219	42.9%	8
H区	59	71.2%	9	91	86.8%	6	186	60.8%	7	153	46.4%	6
I区	107	76.6%	8	185	83.8%	7	311	63.3%	5	228	47.4%	4
Total	1,088	80.1%		1,633	87.3%		2,622	63.4%		2,036	47.0%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	72.6%	2	155	76.8%	6	218	56.4%	8	199	51.8%	2
B区	100	75.0%	1	144	71.5%	8	201	57.2%	7	246	50.8%	3
C区	222	72.5%	3	302	81.1%	1	443	62.1%	4	299	50.5%	4
D区	254	70.5%	4	336	75.3%	7	479	64.5%	2	357	47.9%	6
E区	244	67.2%	8	337	78.0%	5	397	61.2%	6	349	53.0%	1
F区	160	67.5%	7	221	78.3%	4	230	63.0%	3	250	39.2%	9
G区	263	69.6%	5	389	79.4%	3	435	64.8%	1	230	43.9%	8
H区	80	62.5%	9	118	71.2%	9	203	54.7%	9	210	50.5%	5
I区	149	68.5%	6	210	81.0%	2	377	61.5%	5	259	47.1%	7
Total	1,651	69.8%		2,212	77.7%		2,983	61.5%		2,399	48.4%	

表1-3. 現在の喫煙習慣（あり）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	29.2%	8	124	26.6%	4	185	21.6%	4	142	7.7%	1
B区	91	25.3%	3	104	36.5%	9	180	35.0%	9	174	10.9%	7
C区	131	22.9%	2	241	27.4%	5	427	22.0%	6	314	8.9%	2
D区	151	25.8%	5	241	24.9%	2	374	21.9%	5	372	9.4%	4
E区	160	27.5%	7	250	24.0%	1	346	19.7%	3	270	10.4%	5
F区	82	20.7%	1	138	29.7%	7	198	23.7%	7	164	9.1%	3
G区	201	25.4%	4	259	25.9%	3	415	16.1%	1	219	10.5%	6
H区	59	40.7%	9	91	27.5%	6	186	26.9%	8	153	16.3%	9
I区	107	26.2%	6	185	30.8%	8	311	19.6%	2	228	13.2%	8
Total	1,088	26.4%		1,633	27.4%		2,622	21.8%		2,036	10.5%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	7.3%	5	155	14.2%	8	218	12.4%	9	199	1.5%	2
B区	100	10.0%	9	144	13.9%	7	201	10.4%	8	246	5.7%	9
C区	222	4.5%	1	302	7.6%	4	443	3.8%	4	299	3.0%	6
D区	254	9.1%	7	336	11.0%	6	479	3.5%	2	357	1.1%	1
E区	244	5.3%	2	337	6.8%	2	397	4.5%	5	349	1.7%	4
F区	160	5.6%	3	221	7.2%	3	230	6.5%	6	250	1.6%	3
G区	263	5.7%	4	389	6.2%	1	435	2.3%	1	230	1.7%	5
H区	80	7.5%	6	118	19.5%	9	203	7.9%	7	210	3.8%	8
I区	149	9.4%	8	210	8.1%	5	377	3.7%	3	259	3.5%	7
Total	1,651	6.8%		2,212	9.3%		2,983	5.2%		2,399	2.5%	

表1-4. ボランティアの会・グループ参加（月1回以上）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	1.9%	4	124	6.5%	2	185	11.9%	4	142	17.6%	1
B区	91	0.0%	9	104	4.8%	4	180	6.7%	9	174	8.6%	9
C区	131	0.8%	8	241	3.7%	7	427	13.3%	2	314	16.2%	2
D区	151	1.3%	6	241	4.1%	5	374	12.3%	3	372	13.2%	5
E区	160	3.1%	3	250	5.2%	3	346	10.7%	6	270	12.2%	8
F区	82	1.2%	7	138	2.2%	9	198	9.1%	8	164	12.8%	6
G区	201	4.0%	2	259	2.3%	8	415	9.9%	7	219	15.1%	3
H区	59	5.1%	1	91	7.7%	1	186	11.8%	5	153	12.4%	7
I区	107	1.9%	5	185	3.8%	6	311	13.8%	1	228	14.9%	4
Total	1,088	2.2%		1,633	4.2%		2,622	11.4%		2,036	13.8%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	0.0%	8	155	5.8%	4	218	13.3%	8	199	12.6%	9
B区	100	2.0%	4	144	5.6%	6	201	15.9%	7	246	19.1%	5
C区	222	1.8%	6	302	5.0%	8	443	19.9%	2	299	19.7%	4
D区	254	2.8%	2	336	6.8%	2	479	19.6%	3	357	20.7%	2
E区	244	1.6%	7	337	5.6%	5	397	16.4%	6	349	17.8%	6
F区	160	1.9%	5	221	9.0%	1	230	17.4%	5	250	20.4%	3
G区	263	4.6%	1	389	5.9%	3	435	12.9%	9	230	16.5%	8
H区	80	0.0%	9	118	3.4%	9	203	18.7%	4	210	21.4%	1
I区	149	2.0%	3	210	5.2%	7	377	20.4%	1	259	17.0%	7
Total	1,651	2.1%		2,212	6.0%		2,983	17.4%		2,399	18.5%	

表1-5. スポーツの会・グループ参加（月1回以上）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	20.8%	1	124	9.7%	8	185	21.1%	7	142	16.9%	8
B区	91	17.6%	5	104	8.7%	9	180	17.8%	8	174	13.2%	9
C区	131	12.2%	7	241	14.9%	3	427	26.2%	4	314	24.2%	6
D区	151	18.5%	3	241	13.3%	5	374	23.8%	6	372	26.6%	4
E区	160	11.9%	8	250	13.6%	4	346	31.5%	2	270	25.2%	5
F区	82	18.3%	4	138	13.0%	6	198	25.3%	5	164	26.8%	3
G区	201	17.4%	6	259	16.2%	1	415	32.0%	1	219	29.2%	1
H区	59	10.2%	9	91	9.9%	7	186	14.0%	9	153	19.0%	7
I区	107	18.7%	2	185	15.7%	2	311	27.3%	3	228	27.6%	2
Total	1,088	16.3%		1,633	13.5%		2,622	25.7%		2,036	24.1%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	9.5%	1	155	12.9%	9	218	32.1%	7	199	23.6%	8
B区	100	7.0%	4	144	15.3%	8	201	28.9%	8	246	19.5%	9
C区	222	5.4%	9	302	16.6%	6	443	34.1%	3	299	29.8%	2
D区	254	7.1%	3	336	17.6%	5	479	36.3%	1	357	27.7%	5
E区	244	6.6%	6	337	20.8%	2	397	34.0%	4	349	32.7%	1
F区	160	6.3%	7	221	24.0%	1	230	34.3%	2	250	24.0%	7
G区	263	8.4%	2	389	19.3%	4	435	32.9%	5	230	28.3%	4
H区	80	6.3%	8	118	16.1%	7	203	27.1%	9	210	24.8%	6
I区	149	6.7%	5	210	20.0%	3	377	32.6%	6	259	29.3%	3
Total	1,651	7.1%		2,212	18.5%		2,983	33.1%		2,399	27.1%	

表1-6. 趣味の会・グループ参加（月1回以上）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	19.8%	3	124	14.5%	1	185	23.2%	8	142	34.5%	3
B区	91	23.1%	2	104	9.6%	8	180	25.0%	6	174	23.0%	8
C区	131	16.0%	6	241	12.9%	4	427	33.5%	4	314	32.5%	5
D区	151	15.9%	8	241	12.9%	5	374	27.8%	5	372	34.4%	4
E区	160	16.3%	5	250	14.4%	2	346	33.5%	3	270	31.9%	6
F区	82	24.4%	1	138	8.0%	9	198	24.2%	7	164	31.1%	7
G区	201	15.9%	7	259	11.2%	7	415	36.4%	1	219	37.9%	2
H区	59	13.6%	9	91	13.2%	3	186	19.4%	9	153	20.3%	9
I区	107	18.7%	4	185	11.9%	6	311	34.7%	2	228	38.2%	1
Total	1,088	17.7%		1,633	12.2%		2,622	30.3%		2,036	32.3%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	14.0%	2	155	19.4%	5	218	46.3%	5	199	38.2%	8
B区	100	9.0%	8	144	18.8%	7	201	36.3%	9	246	32.1%	9
C区	222	9.9%	6	302	20.5%	4	443	44.7%	7	299	46.5%	3
D区	254	9.1%	7	336	17.0%	8	479	46.3%	4	357	48.5%	1
E区	244	13.5%	3	337	23.7%	1	397	47.1%	2	349	47.9%	2
F区	160	13.1%	5	221	21.3%	3	230	49.1%	1	250	41.2%	6
G区	263	13.3%	4	389	21.9%	2	435	46.0%	6	230	40.4%	7
H区	80	8.8%	9	118	12.7%	9	203	41.9%	8	210	41.4%	5
I区	149	14.1%	1	210	19.0%	6	377	46.9%	3	259	45.6%	4
Total	1,651	11.9%		2,212	20.0%		2,983	45.5%		2,399	43.1%	

表1-7. 町内会・自治会への参加（月1回以上）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	0.0%	7	124	1.6%	8	185	4.3%	9	142	9.2%	6
B区	91	0.0%	7	104	1.9%	6	180	6.1%	7	174	11.5%	1
C区	131	2.3%	1	241	3.3%	4	427	11.0%	1	314	10.2%	4
D区	151	1.3%	4	241	1.7%	7	374	8.6%	6	372	6.2%	9
E区	160	1.3%	5	250	2.4%	5	346	10.4%	2	270	10.4%	3
F区	82	0.0%	7	138	1.4%	9	198	5.6%	8	164	7.3%	7
G区	201	1.5%	3	259	4.2%	3	415	8.7%	4	219	10.5%	2
H区	59	1.7%	2	91	7.7%	1	186	8.6%	5	153	9.8%	5
I区	107	0.9%	6	185	5.4%	2	311	8.7%	3	228	6.6%	8
Total	1,088	1.1%		1,633	3.2%		2,622	8.5%		2,036	8.9%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	0.0%	9	155	2.6%	7	218	8.7%	2	199	10.1%	7
B区	100	2.0%	2	144	4.9%	2	201	7.5%	5	246	15.9%	1
C区	222	3.2%	1	302	3.6%	5	443	8.6%	3	299	11.4%	5
D区	254	1.6%	5	336	5.1%	1	479	7.5%	4	357	12.3%	3
E区	244	1.6%	4	337	1.5%	9	397	5.5%	9	349	9.5%	8
F区	160	0.6%	8	221	2.3%	8	230	7.0%	6	250	8.4%	9
G区	263	1.9%	3	389	4.6%	3	435	6.0%	8	230	11.7%	4
H区	80	1.3%	6	118	3.4%	6	203	9.4%	1	210	14.8%	2
I区	149	0.7%	7	210	4.3%	4	377	6.6%	7	259	11.2%	6
Total	1,651	1.5%		2,212	3.6%		2,983	7.2%		2,399	11.6%	

表1-8. 友人・知人と会う頻度（月1回以上）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	64.2%	3	124	46.0%	1	185	55.7%	9	142	59.9%	2
B区	91	68.1%	2	104	33.7%	8	180	59.4%	5	174	51.7%	8
C区	131	58.8%	6	241	41.1%	6	427	56.7%	8	314	57.6%	4
D区	151	62.9%	5	241	41.5%	5	374	58.3%	6	372	54.8%	6
E区	160	56.9%	9	250	43.6%	4	346	62.1%	2	270	53.7%	7
F区	82	68.3%	1	138	44.9%	2	198	61.1%	3	164	54.9%	5
G区	201	63.7%	4	259	44.8%	3	415	56.9%	7	219	62.1%	1
H区	59	57.6%	7	91	30.8%	9	186	59.7%	4	153	51.6%	9
I区	107	57.0%	8	185	38.9%	7	311	62.4%	1	228	58.8%	3
Total	1,088	61.8%		1,633	41.5%		2,622	59.0%		2,036	56.2%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	75.4%	2	155	65.8%	2	218	74.3%	8	199	78.4%	1
B区	100	71.0%	7	144	65.3%	3	201	72.6%	9	246	76.4%	3
C区	222	71.6%	5	302	51.3%	8	443	76.3%	4	299	74.6%	5
D区	254	74.0%	3	336	63.1%	4	479	82.9%	1	357	74.2%	6
E区	244	78.7%	1	337	66.2%	1	397	74.8%	7	349	71.1%	8
F区	160	73.8%	4	221	57.0%	7	230	76.1%	5	250	76.0%	4
G区	263	71.1%	6	389	61.7%	5	435	75.4%	6	230	72.2%	7
H区	80	70.0%	8	118	49.2%	9	203	78.8%	2	210	76.7%	2
I区	149	69.1%	9	210	57.1%	6	377	77.2%	3	259	71.0%	9
Total	1,651	73.2%		2,212	60.1%		2,983	76.9%		2,399	74.2%	

表1-9. 地域の人々は信頼できる（そう思う、どちらかというとそう思う）［20–64歳］、とても信用できる、まあ信用できる［65歳以上］

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	28.3%	9	124	27.4%	9	185	56.8%	7	142	58.5%	9
B区	91	29.7%	8	104	32.7%	8	180	53.9%	9	174	60.9%	8
C区	131	47.3%	3	241	46.1%	6	427	68.6%	4	314	68.5%	5
D区	151	43.7%	4	241	49.0%	3	374	64.2%	5	372	65.9%	7
E区	160	48.8%	2	250	56.8%	1	346	70.8%	1	270	68.5%	4
F区	82	48.8%	1	138	46.4%	5	198	70.7%	2	164	68.3%	6
G区	201	37.8%	7	259	49.0%	2	415	70.4%	3	219	70.8%	2
H区	59	39.0%	6	91	38.5%	7	186	55.4%	8	153	69.3%	3
I区	107	40.2%	5	185	48.6%	4	311	64.0%	6	228	72.4%	1
Total	1,088	40.9%		1,633	46.2%		2,622	65.4%		2,036	67.4%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	26.8%	8	155	38.1%	7	218	61.0%	8	199	59.8%	9
B区	100	40.0%	7	144	37.5%	8	201	55.2%	9	246	61.4%	8
C区	222	49.1%	3	302	52.6%	4	443	66.8%	5	299	69.9%	5
D区	254	47.2%	6	336	55.1%	1	479	65.1%	6	357	73.7%	1
E区	244	55.3%	1	337	54.9%	2	397	67.5%	4	349	71.6%	3
F区	160	50.6%	2	221	54.8%	3	230	70.0%	1	250	72.4%	2
G区	263	48.3%	5	389	49.4%	5	435	69.9%	2	230	70.9%	4
H区	80	26.3%	9	118	33.1%	9	203	61.1%	7	210	67.1%	6
I区	149	48.3%	4	210	44.3%	6	377	67.6%	3	259	66.0%	7
Total	1,651	45.6%		2,212	49.1%		2,983	65.8%		2,399	68.7%	

表1-10. 地域の人々は助け合っている（そう思う、どちらかというとそう思う）［20–64歳］、他の人の役に立とうとする（とてもそう思う、まあそう思う）［65歳以上］

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	14.2%	9	124	19.4%	9	185	41.1%	6	142	38.0%	9
B区	91	19.8%	8	104	22.1%	8	180	36.7%	8	174	42.5%	8
C区	131	34.4%	1	241	32.0%	3	427	45.0%	5	314	53.5%	3
D区	151	29.8%	4	241	29.0%	6	374	45.5%	3	372	44.4%	7
E区	160	31.9%	2	250	36.4%	1	346	45.1%	4	270	51.1%	5
F区	82	26.8%	5	138	30.4%	5	198	48.5%	1	164	45.1%	6
G区	201	29.9%	3	259	30.9%	4	415	47.2%	2	219	55.3%	1
H区	59	23.7%	7	91	23.1%	7	186	36.0%	9	153	53.6%	2
I区	107	25.2%	6	185	34.1%	2	311	38.6%	7	228	53.1%	4
Total	1,088	27.3%		1,633	30.1%		2,622	43.4%		2,036	49.0%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	15.6%	9	155	20.0%	9	218	48.6%	6	199	46.2%	8
B区	100	35.0%	2	144	29.9%	5	201	45.8%	8	246	44.7%	9
C区	222	38.3%	1	302	41.4%	1	443	51.0%	3	299	52.5%	6
D区	254	33.9%	3	336	39.9%	2	479	46.8%	7	357	56.3%	3
E区	244	33.2%	4	337	34.7%	4	397	49.9%	5	349	55.0%	5
F区	160	31.9%	5	221	36.7%	3	230	51.3%	2	250	55.2%	4
G区	263	28.1%	7	389	28.0%	8	435	50.1%	4	230	58.7%	2
H区	80	25.0%	8	118	28.8%	7	203	42.4%	9	210	59.0%	1
I区	149	28.2%	6	210	29.0%	6	377	52.3%	1	259	51.0%	7
Total	1,651	30.4%		2,212	33.2%		2,983	49.1%		2,399	53.4%	

表1-11. 幸福感（9点、10点）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	23.6%	2	124	16.1%	8	185	15.1%	6	142	18.3%	7
B区	91	20.9%	5	104	20.2%	3	180	14.4%	8	174	17.8%	8
C区	131	19.1%	7	241	19.9%	5	427	18.0%	3	314	17.5%	9
D区	151	21.9%	3	241	18.7%	6	374	17.1%	5	372	18.5%	6
E区	160	24.4%	1	250	22.4%	2	346	21.1%	1	270	20.7%	2
F区	82	20.7%	6	138	23.2%	1	198	18.2%	2	164	23.2%	1
G区	201	17.4%	8	259	18.1%	7	415	17.3%	4	219	20.1%	4
H区	59	13.6%	9	91	9.9%	9	186	12.4%	9	153	20.3%	3
I区	107	21.5%	4	185	20.0%	4	311	15.1%	7	228	19.7%	5
Total	1,088	20.6%		1,633	19.3%		2,622	17.0%		2,036	19.4%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	21.2%	9	155	28.4%	1	218	18.3%	9	199	24.1%	9
B区	100	29.0%	2	144	16.0%	8	201	21.4%	5	246	31.3%	4
C区	222	22.1%	8	302	20.2%	7	443	24.8%	2	299	29.1%	6
D区	254	27.6%	3	336	26.2%	4	479	24.2%	4	357	34.5%	1
E区	244	31.1%	1	337	27.9%	2	397	21.2%	6	349	30.7%	5
F区	160	24.4%	5	221	21.7%	5	230	25.7%	1	250	31.6%	3
G区	263	26.6%	4	389	27.0%	3	435	24.4%	3	230	28.7%	7
H区	80	22.5%	7	118	10.2%	9	203	19.2%	8	210	33.3%	2
I区	149	23.5%	6	210	20.5%	6	377	21.0%	7	259	26.6%	8
Total	1,651	25.7%		2,212	23.4%		2,983	22.7%		2,399	30.3%	

表1-12. 暮らしぶり（大変苦しい、やや苦しい）

	男・20–39歳			男・40–64歳			男・65–74歳			男・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	106	26.4%	2	124	37.9%	4	185	33.5%	5	142	34.5%	8
B区	91	42.9%	9	104	45.2%	8	180	37.8%	8	174	39.1%	9
C区	131	29.8%	5	241	36.9%	3	427	31.1%	4	314	29.0%	6
D区	151	31.8%	6	241	35.7%	2	374	33.7%	6	372	27.7%	4
E区	160	29.4%	4	250	39.2%	5	346	27.7%	2	270	25.9%	2
F区	82	29.3%	3	138	39.9%	6	198	33.8%	7	164	31.7%	7
G区	201	25.4%	1	259	30.5%	1	415	25.8%	1	219	26.9%	3
H区	59	42.4%	8	91	50.5%	9	186	47.8%	9	153	25.5%	1
I区	107	37.4%	7	185	43.8%	7	311	30.2%	3	228	28.5%	5
Total	1,088	31.3%		1,633	38.5%		2,622	32.1%		2,036	29.3%	

	女・20–39歳			女・40–64歳			女・65–74歳			女・75歳–		
	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位	n	該当割合	順位
A区	179	27.4%	3	155	36.8%	7	218	41.3%	7	199	37.2%	9
B区	100	31.0%	7	144	43.1%	8	201	42.8%	9	246	36.6%	8
C区	222	25.2%	1	302	35.1%	3	443	24.8%	1	299	26.8%	5
D区	254	29.1%	4	336	36.3%	4	479	32.8%	6	357	23.0%	1
E区	244	29.9%	6	337	28.5%	1	397	32.0%	5	349	26.6%	4
F区	160	25.6%	2	221	36.7%	5	230	29.6%	4	250	25.2%	2
G区	263	29.7%	5	389	30.3%	2	435	25.5%	2	230	26.5%	3
H区	80	46.3%	9	118	50.0%	9	203	41.4%	8	210	35.2%	7
I区	149	31.5%	8	210	36.7%	6	377	28.9%	3	259	31.3%	6
Total	1,651	29.4%		2,212	35.2%		2,983	31.6%		2,399	29.1%	

続いて、目的 2（格差が大きい指標の抽出）について、結果の一覧を表 2-1～2-3 に示した。ほとんどの指標において、偏差値が 30 未満あるいは 35 未満や 70 以上となる地域が確認され、顕著に悪いもしくは良い地域があることが確認された。それらの中でも、20～39 歳と 40～64 歳のいずれの層においても偏差値 30 未満となる極端に悪い地域が確認された指標は、独居者割合、低所得者割合、低学歴者割合、経済的に苦しい者の割合、友人知人と会う頻度が高い人の割合であった。

表2-1. 各指標を標準化（偏差値換算）した一覧表①

赤: 30未満、橙: 30～35未満、緑: 70以上

20-39歳

	独居者割合	配偶者がいる者の割合	未婚者割合	孤食者割合	低所得者割合	低学歴者割合	高校卒者割合	大学卒者割合	経済的に苦しい者の割合	子どもの頃経済的に苦しかった者の割合	主観的健康感が良い者の割合	幸福感がある者の割合	口腔機能低下者割合	残歯数19本以下の者の割合	残歯数20本以上の者の割合
A区	29.9	43.5	45.8	35.7	59.0	56.3	62.7	58.6	58.1	52.3	52.6	44.0	47.0	59.2	57.1
B区	40.7	52.2	54.3	39.4	42.8	37.6	37.5	36.5	40.8	35.4	34.0	49.1	42.4	47.7	46.2
C区	60.8	43.9	40.9	57.3	52.9	55.3	57.6	55.4	58.1	49.7	61.4	48.1	41.0	39.4	38.3
D区	63.1	60.5	61.8	60.7	52.6	54.3	50.0	54.2	52.8	50.0	47.7	55.0	52.3	60.7	58.7
E区	56.6	63.0	61.9	54.7	56.5	60.4	58.3	62.3	53.5	57.2	66.5	70.2	56.4	52.6	50.9
F区	44.7	64.3	63.6	37.8	60.2	59.6	59.7	59.8	58.3	61.1	46.5	57.1	60.9	57.9	56.0
G区	56.4	39.5	43.7	61.2	54.6	46.8	43.2	41.3	51.1	58.7	36.7	47.3	62.9	52.7	51.0
H区	50.8	35.1	34.7	59.2	26.3	28.8	32.3	33.5	25.7	30.1	48.4	30.8	56.6	29.9	29.3
I区	47.0	48.1	43.4	44.2	45.1	50.9	48.8	48.4	51.5	55.6	56.1	48.4	30.6	64.8	62.5

40-64歳

	独居者割合	配偶者がいる者の割合	未婚者割合	孤食者割合	低所得者割合	低学歴者割合	高校卒者割合	大学卒者割合	経済的に苦しい者の割合	子どもの頃経済的に苦しかった者の割合	主観的健康感が良い者の割合	幸福感がある者の割合	口腔機能低下者割合	残歯数19本以下の者の割合	残歯数20本以上の者の割合
A区	39.5	42.9	38.1	40.9	43.7	51.8	61.1	60.5	54.0	60.5	62.0	58.0	49.2	54.2	54.2
B区	29.7	28.9	34.1	29.0	49.5	44.9	37.8	34.5	39.5	37.5	42.6	31.7	53.6	31.3	31.3
C区	57.7	61.3	63.4	54.5	55.4	57.0	44.7	50.0	57.2	57.4	52.0	60.3	41.3	49.5	49.5
D区	59.2	54.4	54.0	58.5	54.0	53.6	50.8	52.7	55.7	60.0	51.0	56.6	54.8	59.9	59.9
E区	53.6	58.8	54.2	52.7	62.4	59.6	67.6	68.1	61.6	60.3	63.4	58.7	58.3	61.7	61.7
F区	54.8	56.5	57.9	57.0	54.9	55.6	57.0	54.2	52.2	50.1	61.1	52.2	51.1	56.7	56.7
G区	63.0	57.6	61.6	61.9	52.6	50.6	41.5	40.1	57.2	47.3	43.9	46.4	42.6	46.8	46.8
H区	45.4	41.2	45.0	41.4	25.0	24.0	37.2	39.9	28.4	31.5	34.2	34.1	31.4	35.2	35.2
I区	47.0	48.5	41.6	54.0	52.5	52.8	52.3	50.0	44.3	45.3	39.6	52.0	67.8	54.7	54.7

大きい値ほど良好な指標は大きい値ほど高偏差値、小さい値ほど良好な指標は小さい値ほど高偏差値とした

表2-2. 各指標を標準化（偏差値換算）した一覧表②

赤: 30未満、橙: 30～35未満、緑: 70以上

20-39歳	スポーツの会参加者(月1回以上)割合	趣味の会参加者(月1回以上)割合	ボランティア参加者(月1回以上)割合	学習・教養サークル参加者(月1回以上)割合	特技や経験を他者に伝える活動参加者(月1回以上)割合	町内会参加者(月1回以上)割合	週１回以上運動する人の割合	運動を１年以上連続している人の割合	仕事している人の割合	常勤・正規職員者の割合	自営業・家業者の割合	就労していない者の割合	休日勤務（5日以上/月）者の割合	深夜労働者の割合（５日以上/月）	残業している（20時間以上/月）者の割合
A区	67.6	56.5	40.2	35.9	42.6	33.3	72.1	37.6	63.2	69.3	58.1	63.2	56.5	50.1	50.6
B区	57.6	53.7	38.4	42.5	58.3	44.4	51.5	57.7	67.5	59.2	59.4	67.5	49.3	32.4	44.5
C区	39.7	51.2	48.5	46.5	34.5	72.4	44.4	61.0	58.0	51.5	45.8	58.0	35.6	63.7	62.2
D区	54.7	35.1	50.3	47.6	49.2	49.2	41.5	52.1	40.2	39.4	48.9	40.2	57.9	48.6	52.7
E区	39.0	49.3	49.9	45.8	37.9	49.3	47.2	44.1	49.6	50.3	48.7	49.6	54.2	64.2	33.5
F区	48.7	59.8	45.3	65.3	51.6	37.7	46.7	47.4	43.6	53.0	47.4	43.6	65.6	54.7	42.6
G区	51.2	51.9	74.5	49.9	65.0	56.5	44.7	41.7	43.8	43.3	40.6	43.8	35.7	53.0	67.5
H区	34.7	30.6	47.1	30.5	48.4	48.7	39.7	39.8	47.2	33.4	68.3	47.2	54.9	37.7	42.1
I区	56.8	61.9	55.8	66.5	62.5	41.7	62.3	68.6	36.9	50.6	32.8	36.9	40.2	45.6	54.4

40-64歳	スポーツの会参加者(月1回以上)割合	趣味の会参加者(月1回以上)割合	ボランティア参加者(月1回以上)割合	学習・教養サークル参加者(月1回以上)割合	特技や経験を他者に伝える活動参加者(月1回以上)割合	町内会参加者(月1回以上)割合	週１回以上運動する人の割合	運動を１年以上連続している人の割合	仕事している人の割合	常勤・正規職員者の割合	自営業・家業者の割合	就労していない者の割合	休日勤務（5日以上/月）者の割合	深夜労働者の割合（５日以上/月）	残業している（20時間以上/月）者の割合
A区	34.4	53.6	53.8	62.9	46.4	39.1	52.3	59.5	45.8	43.7	71.6	45.8	53.4	52.9	50.9
B区	38.9	43.6	48.4	51.6	44.1	52.1	39.5	51.3	42.8	36.6	62.8	42.8	50.4	41.1	61.3
C区	54.1	59.1	51.0	44.4	45.4	48.8	57.2	49.0	53.8	57.7	39.5	53.8	41.6	69.0	58.2
D区	49.5	45.1	57.7	58.9	49.6	52.1	62.0	52.3	32.8	43.8	43.1	32.8	59.4	51.4	35.3
E区	56.1	66.5	53.9	64.8	55.9	36.9	62.0	51.2	44.0	55.7	45.0	44.0	56.1	63.9	32.6
F区	63.9	49.6	68.0	47.2	74.1	37.7	44.6	45.2	61.2	54.3	45.1	61.2	64.0	43.1	46.7
G区	48.1	39.4	48.0	47.6	45.2	62.7	44.4	42.7	55.0	56.0	46.9	55.0	52.7	42.4	60.8
H区	40.9	33.8	35.1	34.2	52.7	66.4	56.5	68.4	46.5	35.4	43.3	46.5	43.5	37.8	57.0
I区	64.1	59.5	34.0	38.3	36.5	54.3	31.5	30.4	67.9	66.8	52.7	67.9	28.9	48.5	47.2

大きい値ほど良好な指標は大きい値ほど高偏差値、小さい値ほど良好な指標は小さい値ほど高偏差値とした

表2-3. 各指標を標準化（偏差値換算）した一覧表③

赤: 30未満、橙: 30～35未満、緑: 70以上

20-39歳	友人知人と会う頻度が高い(月1回以上)者の割合	交流する友人（0～2人）がいる者の割合	交流する友人（3～9人）がいる者の割合	交流する友人（10人以上）がいる者の割合	地域活動の参加意向がある者の割合	喫煙する者の割合	5年以上喫煙している者の割合	飲酒者割合	健診(1年以内)未受診者割合	1年間に歯科検診を受けている者の割合
A区	58.8	52.4	42.1	57.9	51.4	50.9	53.0	30.2	61.2	58.5
B区	53.8	35.8	42.4	39.6	42.8	45.3	38.5	43.3	62.6	51.2
C区	54.8	59.1	71.8	45.3	56.0	63.2	54.7	50.0	51.0	45.3
D区	53.1	55.2	51.9	54.4	65.5	51.3	46.2	54.9	59.8	48.6
E区	53.8	55.2	55.2	52.2	61.5	54.8	67.8	59.1	47.6	49.2
F区	59.7	55.8	58.2	50.9	56.4	65.1	55.4	42.8	44.4	58.0
G区	52.1	57.9	37.2	67.3	42.2	48.4	50.5	66.6	51.3	55.7
H区	29.7	28.5	44.1	30.5	36.5	32.1	30.9	55.1	29.3	24.9
I区	34.2	50.1	47.2	52.0	37.6	38.8	53.0	48.2	42.8	58.6

40-64歳	友人知人と会う頻度が高い(月1回以上)者の割合	交流する友人（0～2人）がいる者の割合	交流する友人（3～9人）がいる者の割合	交流する友人（10人以上）がいる者の割合	地域活動の参加意向がある者の割合	喫煙する者の割合	5年以上喫煙している者の割合	飲酒者割合	健診(1年以内)未受診者割合	1年間に歯科検診を受けている者の割合
A区	61.7	62.4	54.3	63.5	61.5	43.9	47.4	38.3	44.5	39.6
B区	52.8	36.1	38.7	41.1	34.3	34.5	58.5	55.1	30.1	44.9
C区	43.1	53.4	56.3	48.8	53.0	61.0	42.2	66.7	67.2	62.1
D区	57.0	56.1	59.4	49.7	49.3	54.6	42.7	46.9	51.5	54.0
E区	60.5	65.5	64.0	58.6	62.1	62.2	72.1	32.7	56.0	42.0
F区	53.0	53.5	43.0	61.7	55.7	57.3	45.9	45.1	59.0	60.9
G区	52.9	38.7	36.0	47.2	49.8	55.7	55.0	58.9	50.6	60.2
H区	29.5	41.4	58.7	29.6	31.9	34.9	49.4	49.6	42.4	53.8
I区	39.5	42.9	39.6	49.8	52.3	45.9	36.8	56.7	48.7	32.6

大きい値ほど良好な指標は大きい値ほど高偏差値、小さい値ほど良好な指標は小さい値ほど高偏差値とした

D．考察と結論

成人層と高齢層のいずれの年代においても不利な状況が固定化されている地域・指標が一定数見つかった一方、成人層で状況が好転している地域・指標や、逆に成人層で悪化している地域・指標も見つかった。B 区や H 区は、不利な状況が固定化している指標と成人層で改善している指標とが混在していた。一方、C 区や D 区においては、成人層において悪化している指標が散見された。今後は、なぜ年代を越えて固定化されているのか、あるいは成人層で好転・悪化しているのかについて、追加のデータ分析やフィールド調査などによる要因探索が求められる。

また、成人層の各年代に共通して格差が大きい指標として、独居者割合、低所得者割合、低学歴者割合、経済的に苦しい者の割合などの社会経済的な指標が確認された。これらの指標が悪かった地域に対して、短期的な対策で各指標を改善させることは困難であるが、この現状を把握した上で中長期的な目標を立てることが肝要であろう。

E. 研究発表

1. 論文発表

なし

2. 学会発表

なし

（発表誌名巻号・頁・発行年等も記入）

F. 知的財産権の出願・登録状況

（予定を含む。）

1. 特許取得

なし

2. 実用新案登録

なし

令和元年度厚生労働科学研究費補助金
（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
分担研究報告書

若年層における健康格差の見える化にむけた地域診断システムの可能性

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研究要旨：本研究では、兵庫県A市における若年層（20 歳以上 65 歳未満）対象調査データを活用し、若年層における健康格差の見える化にむけた地域診断システムの可能性を検討した。過去に開発した高齢者の健康格差の見える化を目的にした「JAGES 地域診断システム」をプラットフォームとし、若年層調査データを追加した。分析の結果、若年層においても、「友人 10 人以上」、「友人と会う頻度」、「趣味」、「スポーツ」、「学習・教養サークル」などといった他者との交流に「健康格差縮小」の可能性があることが示唆された。高齢者との比較では、多くの指標で年齢層を問わず同様の関連を示したが、高齢者よりも若年層で幸福や健康との関連がより強く示される指標も目立った。「喫煙」や「口腔機能低下」、「健診未受診」は、若年層においても幸福や健康を阻害するリスクがあることが示唆された。若年層と高齢者で異なった指標として、「地域活動参加意向」は、若年層のみで幸福感、健康度自己評価と正の相関があった。また、「独居者」、「孤食者」については、幸福は若年層と高齢者で同傾向だが、健康は若年層では相関がなく、「孤食」や「独居」の健康への影響は年齢層で異なることが示唆された。以上のことから、若年層でも地区単位での差（分散）が確認され、年齢層によるいくつかの相違に留意する必要はあるものの、若年層においても高齢者と同様に、データに基づく地域診断によって健康格差を見える化することの有用性が示された。

A．研究目的

日本老年学的評価研究（JAGES）プロジェクトでは、介護予防に取り組む地方自治体が現状や課題を「見える化」することを目的に、高齢者における健康の公平性評価・対応ツール「JAGES HEART」（地域マネジメント支援システム）を開発してきた（https://www.jages.net/project/jagesheart/）。なお、本システムは、WHOの「Urban HEART」(都市における健康の公平性評価・対応ツール)を参考とし、WHO神戸センターと連携して開発したものである。本システムは、その後、厚生労働省による「地域包括ケア『見える化』システム」のプロトタイプとしても活用されている。

本研究では、特定の自治体において、既存の「JAGES地域診断システム」に若年層を対象にした調査データを追加し、若年層における健康格差の見える化にむけた地域診断システムの可能性を検討した。

B．研究方法

兵庫県A市で行った若年層調査結果（40 指標）を既存の「JAGES 地域診断システム」に投入し、行政区毎（12 の行政区比較）の「幸福感」および「健康度自己評価（健康感）」の 2 指標と他の 38 指標間の相関係数を算出し、若年層における、幸福感および健康度自己評価と関連の強い指標を確認した（調査の概要は参考資料 1 を参照）。

JAGES 高齢者調査と共通する指標（21 指標）については、神戸市の高齢者調査（78 の包括区比較）、

全国 40 市町の高齢者調査（40 市町比較）における同様の相関係数と比較し、若年層、高齢者の特徴を分析するとともに、「JAGES 地域診断システム」を幅広い世代での健康格差縮小に向けたツールとして活用する上での留意点を確認した。
なお、若年層データを投入した「JAGES地域診断システム」では、78のあんしんすこやかセンター比較も可能であったが、今回の回答人数では結果が安定しないと思われるため、若年層の分析では12の行政区比較を用いた。また、3つの調査の概要を末尾に記載した。

表１：兵庫県A市における若年層の健康格差見える化にむけた地域診断指標群

	A市独自	高齢コア	高齢重要	報告書表記	A市地域診断指標
1	共通	―	○	独居	独居者割合
2	○	―	―	有配偶	配偶者がいる人の割合
3	○	―	―	未婚	未婚者割合
4	共通	―	○	孤食	孤食者割合
5	共通	―	○	低所得	低所得者割合
6	共通	―	○	低学歴	低学歴者割合
7	○	―	―	高卒	高校卒者割合
8	○	―	―	大卒	大学卒者割合
9	○	―	―	経済苦	経済的に苦しい者の割合
10	○	―	―	経済苦（子供）	子どもの頃経済的に苦しかった者の割合
11	共通	―	○	健康感	主観的健康感が良い者の割合
12	共通	―	○	幸福感	幸福感がある者の割合
13	共通	○	―	口腔低下	口腔機能低下者割合
14	共通	○	―	残歯19以下	残歯数19本以下の者の割合
15	○	―	―	残歯20以上	残歯数20本以上の者の割合
16	共通	○	○	スポーツ	スポーツ関係のグループ参加者割合(月1回以上)
17	共通	○	○	趣味	趣味関係グループへの参加者割合(月1回以上)
18	共通	○	○	ボランティア	ボランティア活動への参加者割合(月1回以上)
19	共通	○	○	学習・教養	学習・教養サークル参加者(月1回以上)割合
20	共通	○	○	特技・経験	特技や経験を他者に伝える活動参加者(月1回以上)割合
21	○	―	―	町内会	町内会参加者(月1回以上)割合
22	○	―	―	運動週1超	週１日以上運動する人の割合
23	○	―	―	運動継続	運動を１年以上継続している人の割合
24	○	―	―	就労	仕事している人の割合
25	○	―	―	正規職員	常勤・正規職員者の割合
26	○	―	―	自営・家業	自営業・家業者の割合
27	共通	―	○	非就労	就労していない者の割合
28	○	―	―	休日勤務	休日勤務（5日以上/月）
29	○	―	―	深夜労働	深夜労働（５日以上/月）
30	○	―	―	残業	残業時間（20時間以上/月）
31	共通	○	○	友人頻度	友人と会う頻度月１回以上の割合
32	共通	○	○	友人0～2	交流する友人（0～2人）がいる者の割合
33	共通	○	○	友人3～9	交流する友人（3～9人）がいる者の割合
34	共通	○	○	友人10超	交流する友人（10人以上）がいる者の割合
35	共通	―	○	地域活動	地域活動の参加意向がある者の割合
36	共通	―	○	喫煙者	喫煙者の割合
37	○	―	―	喫煙５年超	５年以上喫煙している者の割合
38	○	―	―	飲酒	飲酒者の割合
39	共通	―	○	健診未受診	健診(1年以内)未受診者割合
40	○	―	―	歯科検診	１年間に歯科検診を受けている者の割合
以上の、共通21指標＋独自19指標＝40指標					
なお、報告書では、残歯20以上は除いた。（残歯19以下があるため）					

（倫理面への配慮）

本研究は、厚生労働省「人を対象とする医学系研究に関する倫理指針」等を遵守し、個人情報（氏名や住所など個人が特定できるもの）を削除したデータを用いた。神戸市の倫理審査委員会にて承認された「JAGES プロジェクト-若年層および高齢者の健康とくらしに関する疫学研究-」データの二次利用、および国立研究開発法人国立長寿医療研究センター（992、1244）の倫理・利益相反委員会で承認を受けて研究を行った。

C．研究結果

1）若年層における幸福感・健康度自己評価の関連要因

神戸地域診断指標39（残歯20以上除く）指標のうち、幸福感および健康度自己評価（健康感）のいずれとも、相関が強い（相関係数±0.6以上）指標は、社会経済的指標（「大卒」、「低学歴」、「経済苦」等）の他、正の相関で、「地域活動」、「学習・教養サークル」、「友人10人超」、「友人と会う頻度」、「有配偶」、負の相関で「残歯数19本以下」、「交流する友人0-2人」、「喫煙」、「口腔機能低下」等であった。

幸福感または健康度自己評価のいずれかと相関の強い指標では、「ボランティア」、「スポーツ」は幸福感と、「飲酒」は健康度自己評価と正の相関が強かった。一方、負の相関では、「運動1年以上」、「町内会」は健康度自己評価と負の相関が強かった。（表２）

表２：兵庫県Ａ市における地域単位の幸福感・健康度自己評価の関連（地域相関分析）

	幸福感との相関順			
	若年層全体（A市）202005修正			
	△は正相関0.3以上、▲は0.6以上。▽は、負相関−0.3以下、▼は−0.6以下。			
A市地域診断指標【略表記】（赤字は若年独自項目）	幸福感との相関順		健康感との相関順	
幸福感	―	1	▲	0.778
地域活動	▲	0.931	▲	0.888
大学卒	▲	0.888	▲	0.928
学習・教養	▲	0.883	▲	0.686
友人10超	▲	0.807	▲	0.663
有配偶	▲	0.78	▲	0.48
健康感	▲	0.778	―	1
趣味の会	▲	0.728	▲	0.736
ボランティア	▲	0.698	△	0.34
スポーツ	▲	0.677	△	0.311
友人頻度	▲	0.605	▲	0.743
正規職員	△	0.572	△	0.577
残業	△	0.538	△	0.564
歯科検診	△	0.502	△	0.478
運動週1	△	0.449	△	0.551
友人3-9		0.253	△	0.52
飲酒		0.202	▲	0.642
非就労		0.157		0.057
就労		0.157		−0.057
特技・経験		−0.034		−0.019
休日勤務	▽	−0.322	▼	−0.607
独居	▽	−0.335		0.021
運動1年	▽	−0.382	▼	−0.734
町内会	▽	−0.396	▼	−0.813
自営	▽	−0.448		0.032
孤食	▽	−0.543		−0.054
未婚	▽	−0.599	▽	−0.304
喫煙5年超	▼	−0.727	▼	−0.789
口腔機能低下	▼	−0.733	▼	−0.617
健診未受診	▼	−0.778	▽	−0.5
深夜労働	▼	−0.821	▽	−0.596
喫煙	▼	−0.878	▼	−0.705
経済苦	▼	−0.884	▼	−0.778
低所得	▼	−0.892	▼	−0.712
友人0-2	▼	−0.892	▼	−0.927
経済苦（子供）	▼	−0.919	▼	−0.811
低学歴	▼	−0.922	▼	−0.706
残歯19以下	▼	−0.925	▼	−0.838

	健康感との相関順			
	若年層全体（A市）202005修正			
	△は正相関0.3以上、▲は0.6以上。▽は、負相関−0.3以下、▼は−0.6以下。			
A市地域診断指標【略表記】（赤字は若年独自項目）	幸福感との相関順		健康感との相関順	
健康感	▲	0.778	―	1
大学卒	▲	0.888	▲	0.928
地域活動	▲	0.931	▲	0.888
幸福感	―	1	▲	0.778
友人頻度	▲	0.605	▲	0.743
趣味の会	▲	0.728	▲	0.736
学習・教養	▲	0.883	▲	0.686
友人10超	▲	0.807	▲	0.663
飲酒		0.202	▲	0.642
正規職員	△	0.572	△	0.577
残業	△	0.538	△	0.564
運動週1	△	0.449	△	0.551
友人3-9		0.253	△	0.52
有配偶	▲	0.78	△	0.48
歯科検診	△	0.502	△	0.478
ボランティア	▲	0.698	△	0.34
スポーツ	▲	0.677	△	0.311
非就労		0.157		0.057
自営	▽	−0.448		0.032
独居	▽	−0.335		0.021
特技・経験		−0.034		−0.019
孤食	▽	−0.543		−0.054
就労		0.157		−0.057
未婚	▽	−0.599	▽	−0.304
健診未受診	▼	−0.778	▽	−0.5
深夜労働	▼	−0.821	▽	−0.596
休日勤務	▽	−0.322	▼	−0.607
口腔機能低下	▼	−0.733	▼	−0.617
喫煙	▼	−0.878	▼	−0.705
低学歴	▼	−0.922	▼	−0.706
低所得	▼	−0.892	▼	−0.712
運動1年	▽	−0.382	▼	−0.734
経済苦	▼	−0.884	▼	−0.778
喫煙5年超	▼	−0.727	▼	−0.789
経済苦（子供）	▼	−0.919	▼	−0.811
町内会	▽	−0.396	▼	−0.813
残歯19以下	▼	−0.925	▼	−0.838
友人0-2	▼	−0.892	▼	−0.927

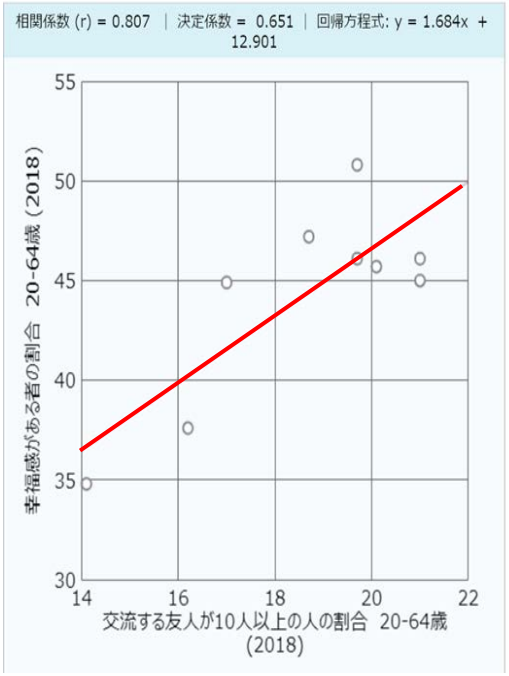
2）高齢者との比較

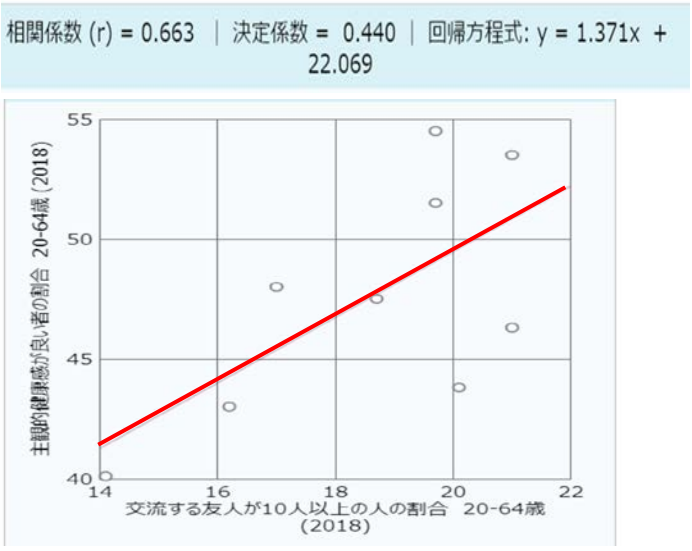
神戸地域診断指標39指標のうち、高齢者地域診断指標と共通する21指標について、年代間で、幸福感および健康度自己評価との相関に相違があるかを比較した。21指標のうち、多くは若年層と高齢者で同様の相関を示したが、いくつかの指標では若年層と高齢者で異なる傾向が読み取れた。以下の分析は、神戸市の若年層と高齢者の相関の分布をグラフ化し行った。（高齢者（全国）を含む全指標の結果は参考資料２（章末）を参照）

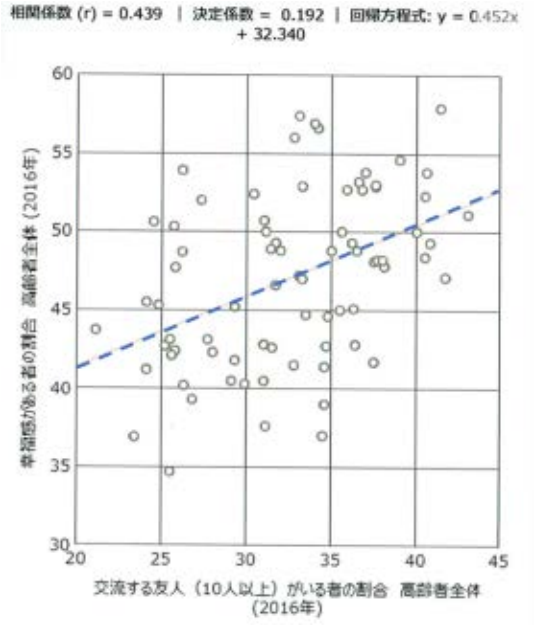
① 社会関係指標

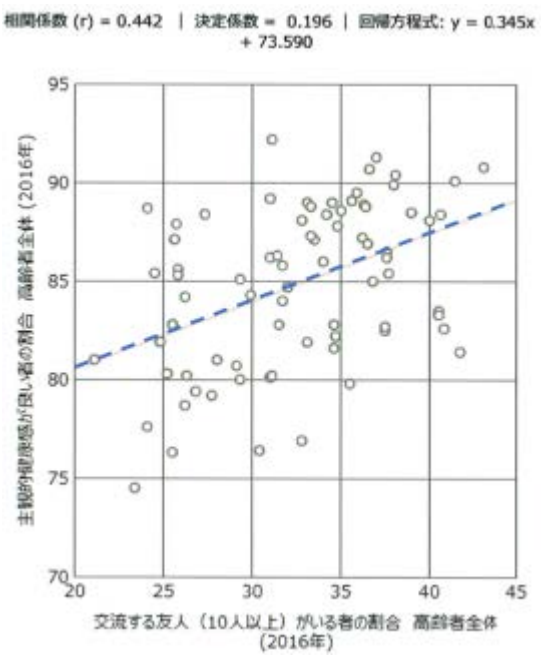
「交流する友人数（10人以上）」については、若年層・高齢者にかかわらず、幸福感および健康度自己評価と正の相関関係があり、とくに若年層で強い相関関係が認められた。なお、交流する友人数が10人以上の割合自体は、若年層の方が高齢者よりも小さくなっていた（図１）。

図１：交流する友人が10人以上いる人の割合と幸福感・健康度自己評価との関連



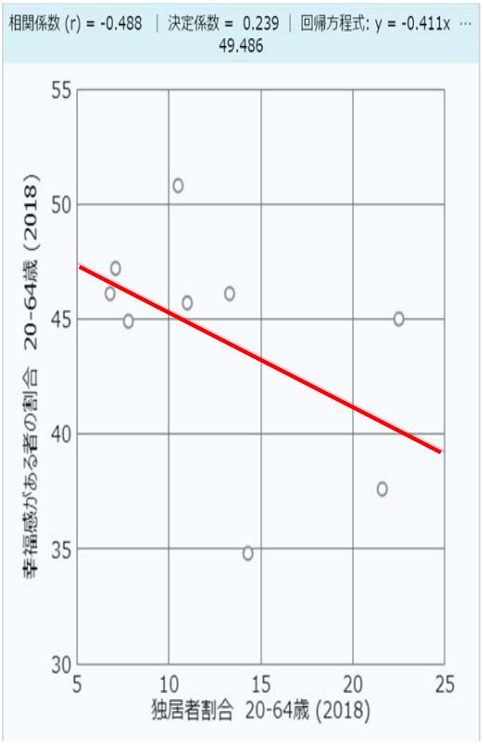


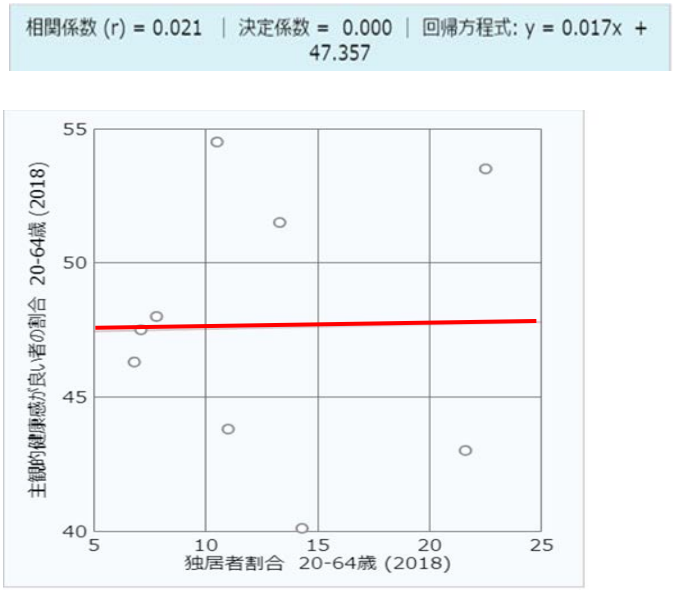


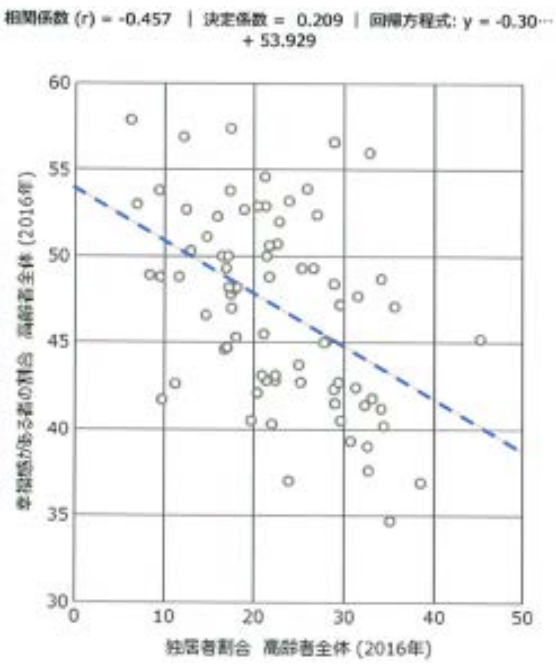


「独居者の割合」については、幸福感については若年層と高齢者で同傾向だが、健康度自己評価は若年層での相関はなかった。なお、「独居者の割合」は、高齢者と比べて若年層では少なくなっていた（図２）。「孤食者の割合」についても、同様の傾向で、若年層では健康度自己評価との相関はなかった（図３）。なお、「孤食者」の割合は、年代によって顕著な差はみられなかった。

図２：独居者割合と幸福感・健康度自己評価との関連







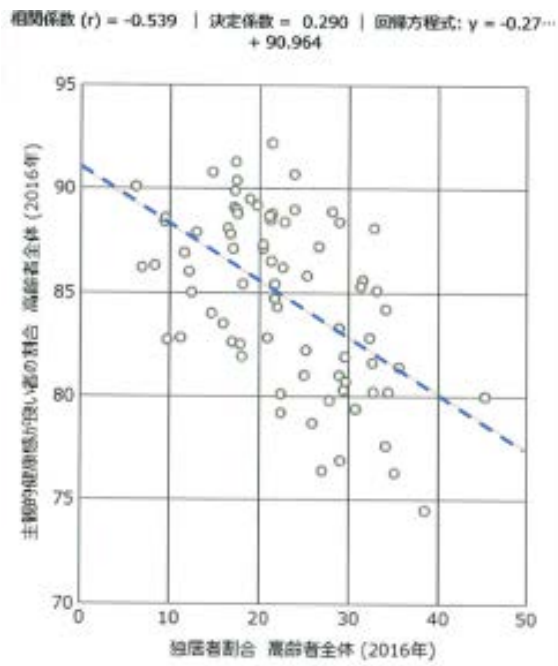
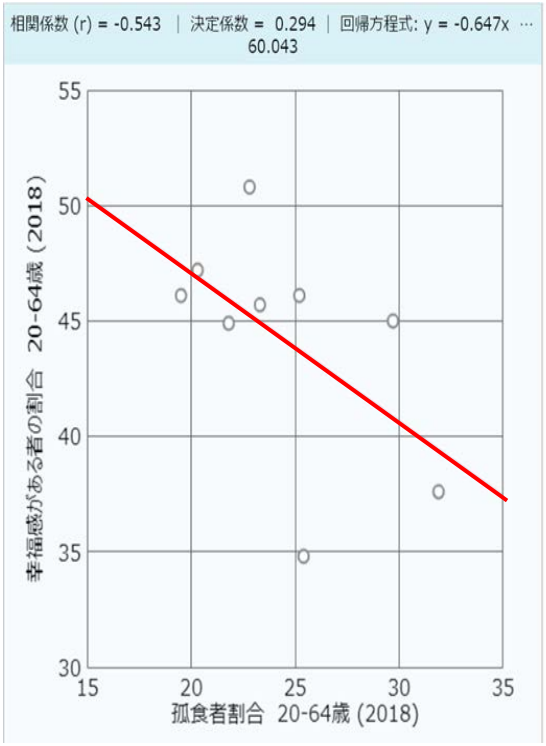
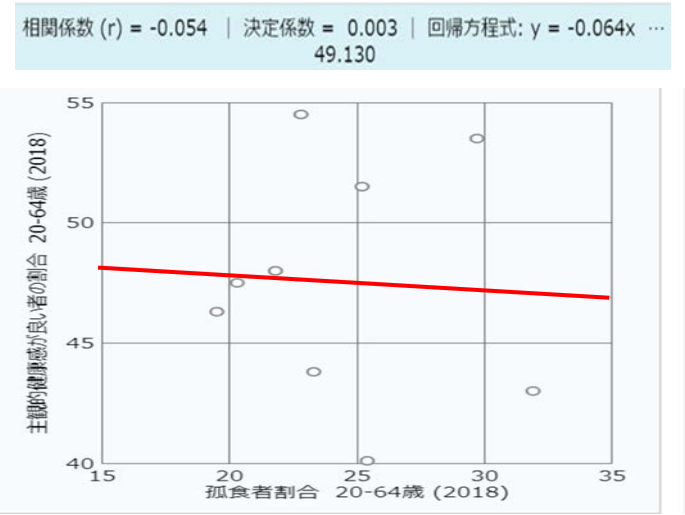
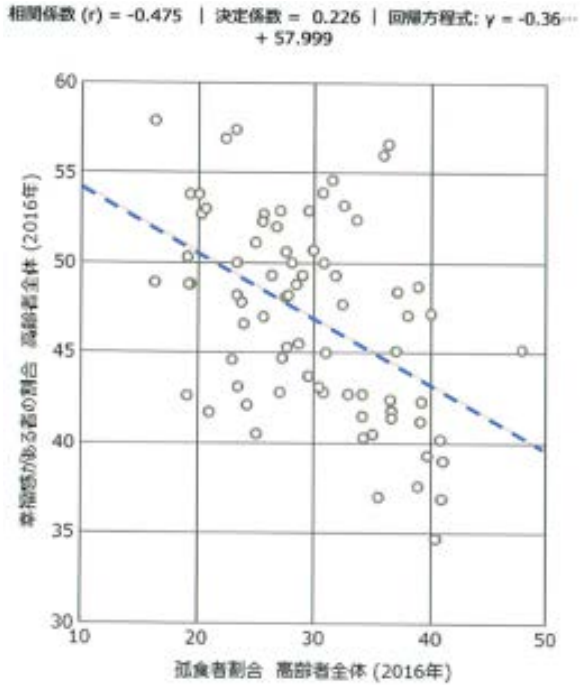
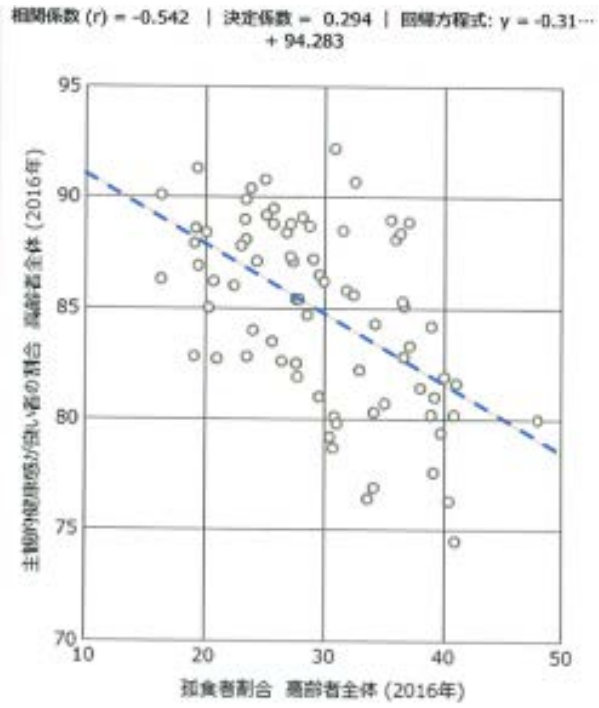


図３：孤食者割合と幸福感・健康度自己評価との関連





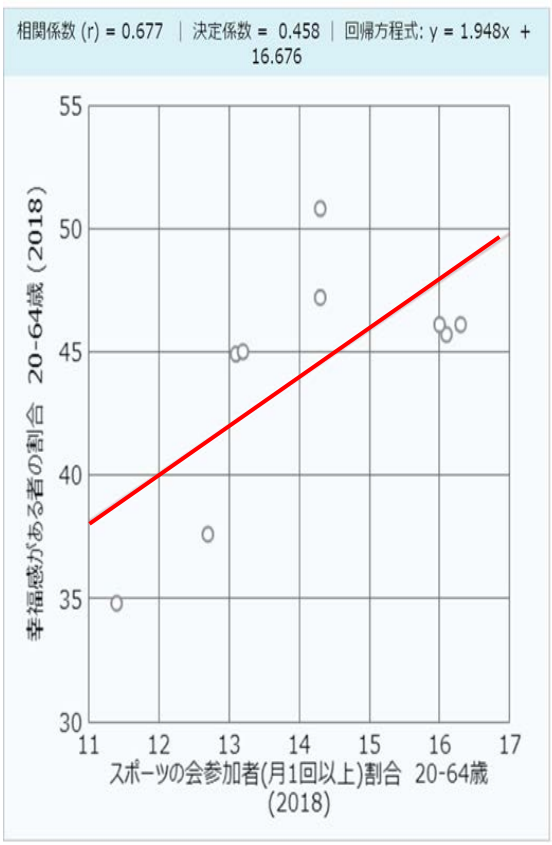


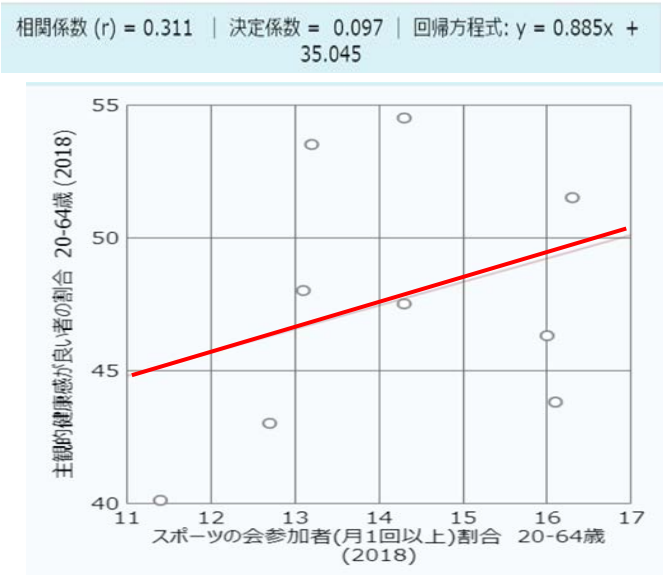


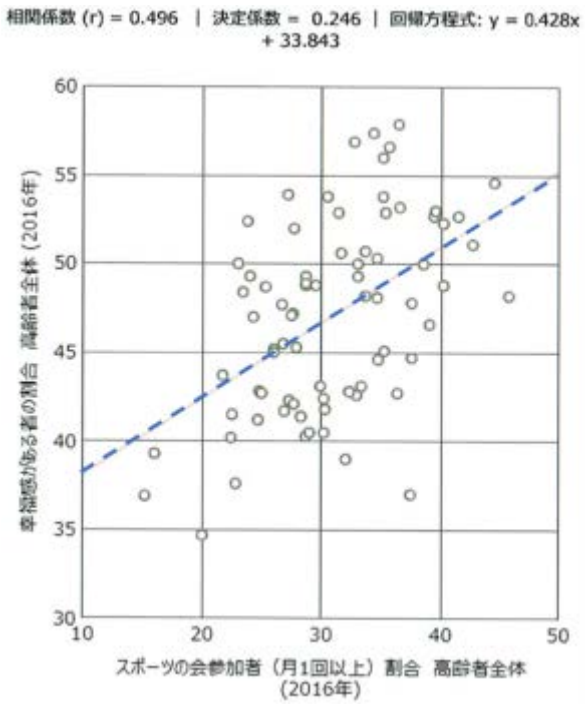
② 社会参加指標

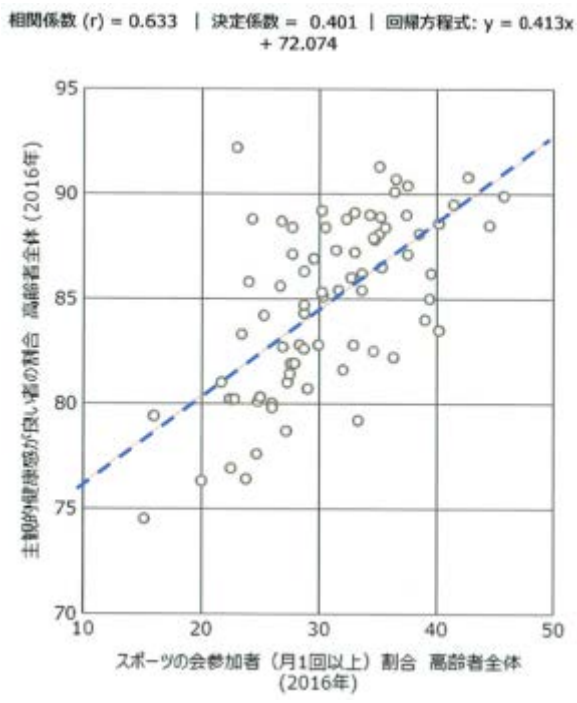
「スポーツの会参加者（月1回以上）割合」は、若年層・高齢者に関わらず、幸福感・健康度自己評価と強いまたはやや強い正の相関を示したが、若年層では幸福感と、高齢者では健康度自己評価との相関が強かった。なお、スポーツの会参加者（月1回以上）の割合は、若年層の方が高齢者よりも小さくなっていた（図４）。

図４：スポーツの会参加者割合と幸福感・健康度自己評価との関連



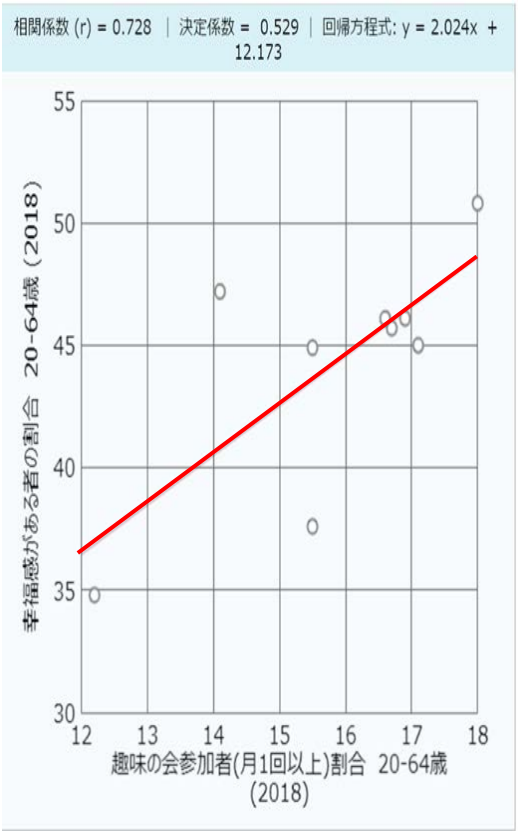


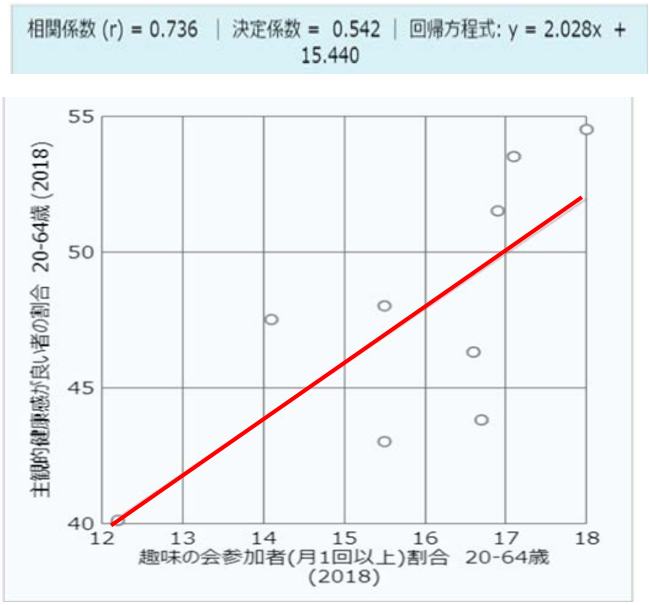


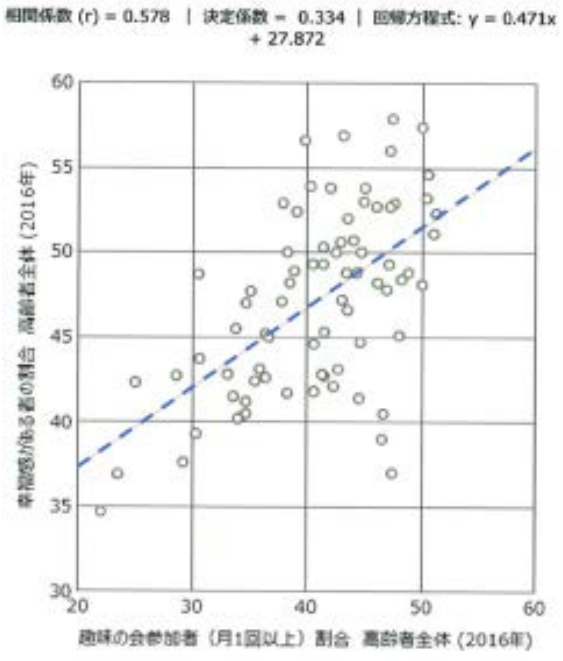


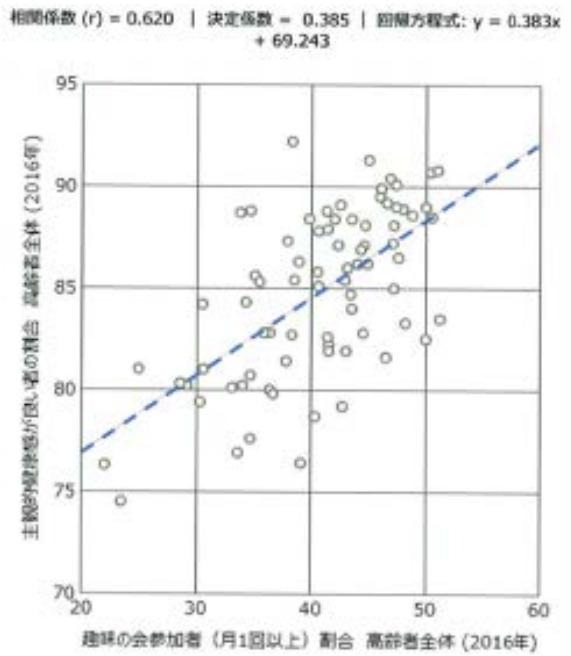
「趣味関連のグループへの参加者（月1回以上）割合」についても、若年層、高齢者ともに幸福感、健康度自己評価と強い正の相関を示したが、その傾向は若年でより強い結果であった（図５）。「趣味関連のグループへの参加者（月1回以上）」の割合でも、高齢層と比べて、若年層では顕著に小さくなっていた。

図５：趣味関係のグループへの参加者割合と幸福感・健康度自己評価との関連



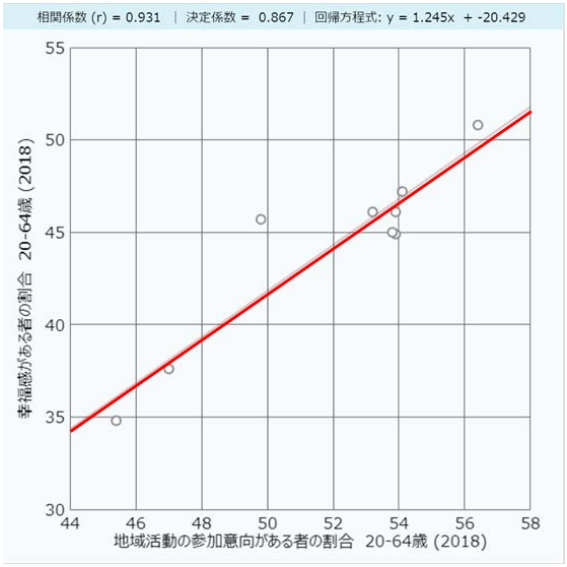


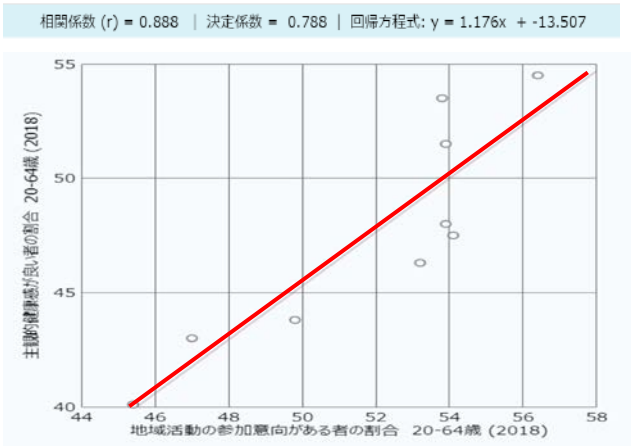


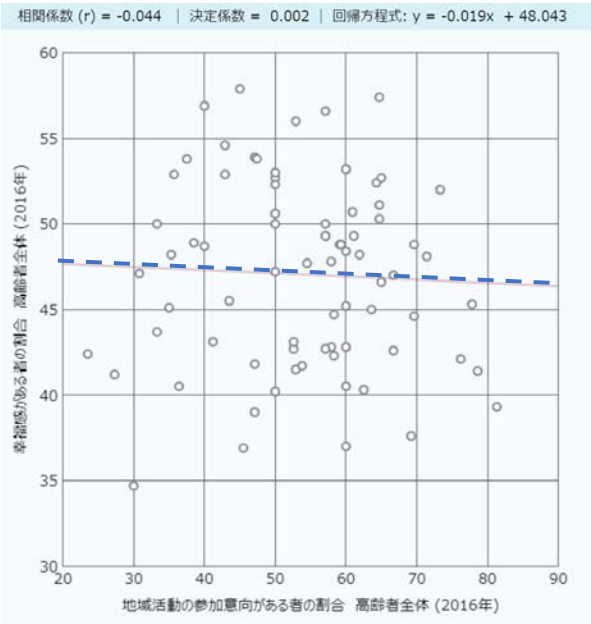


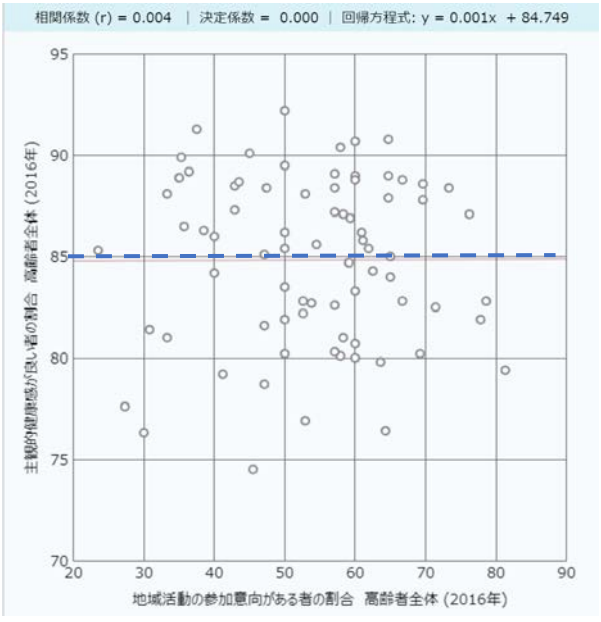
「地域活動参加意向者割合」については、若年層でのみ、幸福感および健康度自己評価と強い正の相関を示した（図６）。「地域活動参加意向者割合」は、高齢者で地域間の分散が大きい点には留意する必要がある。

図６：地域活動の参加者意向者割合と幸福感・健康度自己評価との関連





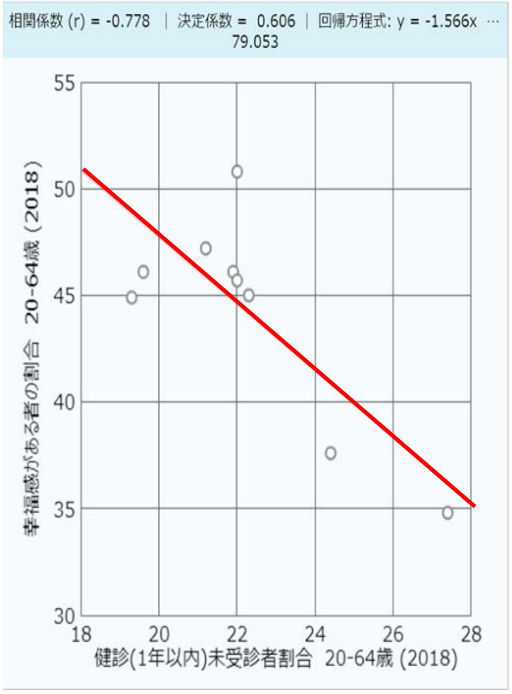


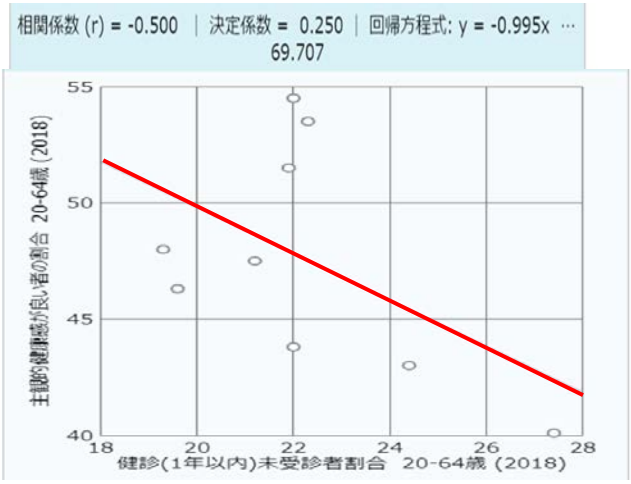


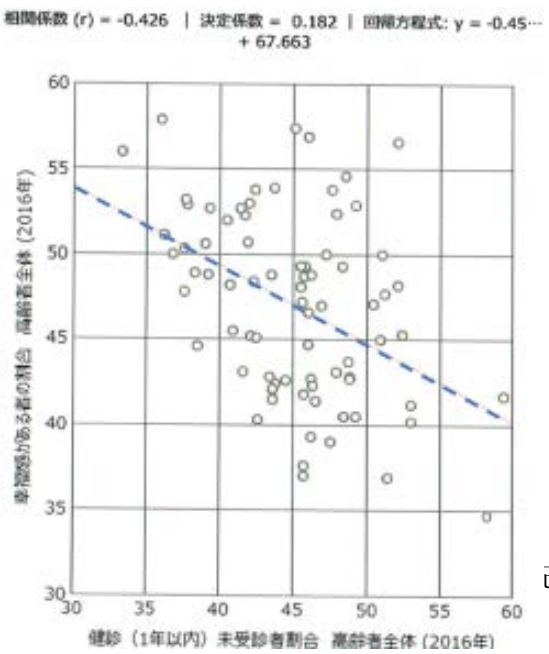
③ 健診・残歯数

「健診（1年以内）未受診者割合」については、若年層・高齢者に関わらず、幸福感および健康度自己評価と負の相関を示していた。若年層では、特に幸福で強い負の相関であった。「健診（1年以内）未受診者」の割合は、若年層の方が高齢者をかなり下回っていた。（図７）。

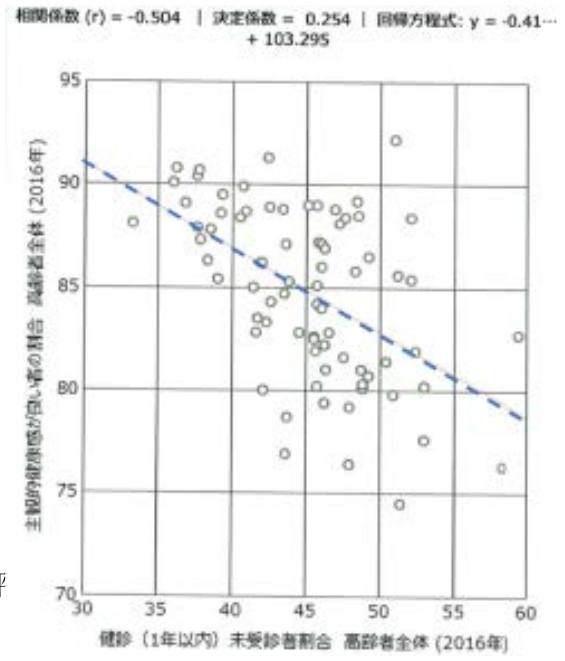
図７：健診未受診割合と幸福感・健康度自己評価との関連





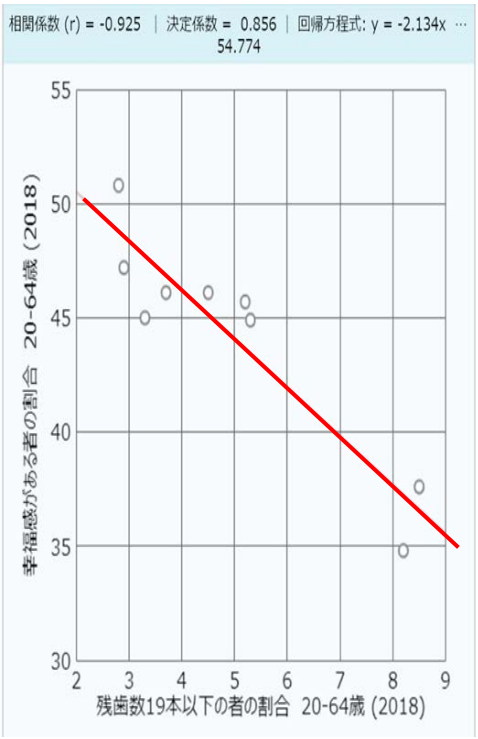


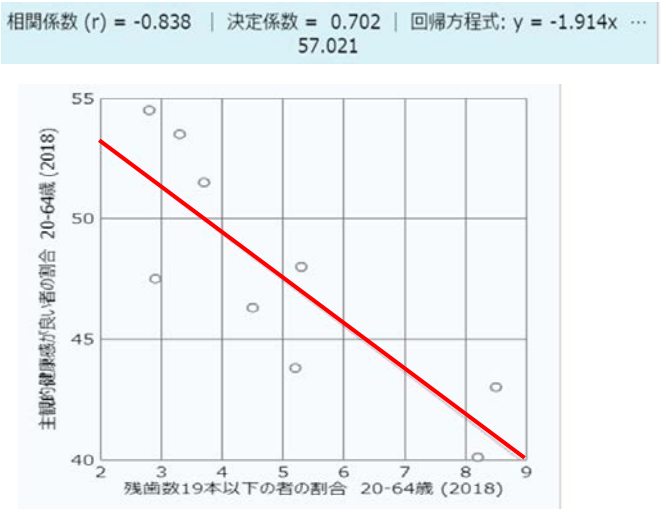
己評

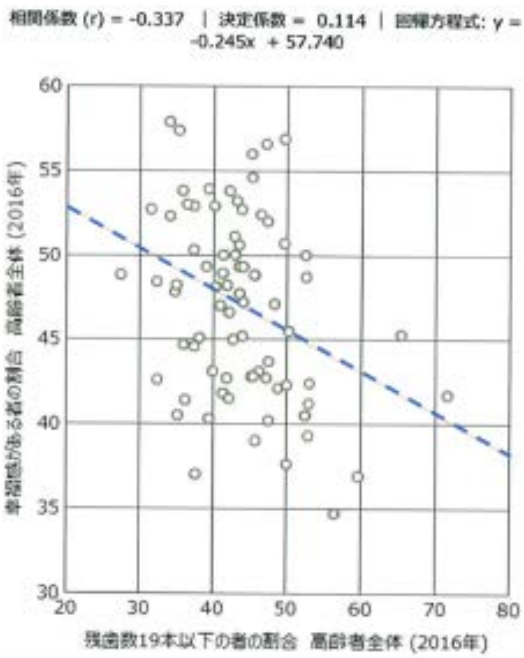


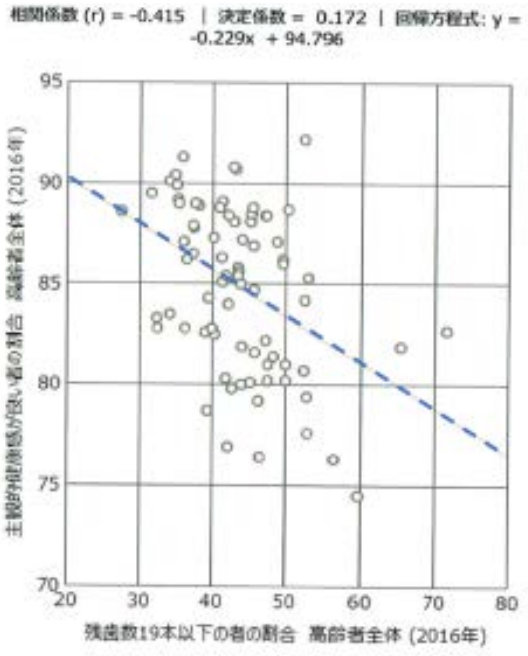
「残歯19本以下の者の割合」については、若年層では、幸福感および健康度自己評価と強い負の相関関係、高齢者ではやや強い負の相関を示していた。ただし、「残歯19本以下の者の割合」は、若年層と高齢者で大きく異なる点には留意する必要がある（図８）

図８：残歯19本以下の者の割合と幸福感・健康度自己評価との関連









D．考　　察

1）若年層における地域診断指標の分析

若年層においても、地域単位での社会経済的な指標は幸福感や健康度自己評価と強い相関関係が認められた。具体的には、「大学卒」、「正規職員」は正の相関関係、「低学歴」、「低所得」は負の相関関係が認められた。

また、社会経済指標以外では、「地域活動参加意向」、「学習・教養サークル」、「趣味関係」、「友人10人以上」、「友人と会う頻度」、「有配偶」で正相関が強く、「残歯19本以下」、「交流する友人（０～２人)」、「喫煙」、「口腔機能低下」では負の相関が強かった。この他、「スポーツ」は健康度自己評価より幸福感と、「飲酒」は幸福感より健康度自己評価と正の相関が強かった。また、負の相関では、「運動１年超」、「町内会」、は健康度自己評価と負の相関が強かった。

これらの結果から、若年層においても、「友人10人以上」、「友人と会う頻度」、「地域活動参加意向」、「学習・教養サークル」、「趣味関係」、「スポーツ」などといった他者との交流に「健康格差縮小」の可能性があることが示唆された。また、「飲酒」よりも「喫煙」に、健康を阻害するリスクが大きいことも示唆された。

2）年齢層による相違点

若年層、高齢者ともに「交流する友人（10 人以上)」の割合が幸福感、健康度自己評価が高い人の割合と正の相関を示したように、多くの指標が年代に関わらず同様の関連を示すことが明らかになった。「孤食」や「独居」には年齢層による違いがあった。若年層でも高齢者と同様に「孤食者」の割合が多いほど幸福感が低い地区であることが示されたが、健康度自己評価については高齢者と異なり相関がなかった。「独居者」の割合も若年層では健康度自己評価との関連はなく、「孤食」や「独居」の健康への影響は、若年層と高齢層とで異なることが示唆された。

年代により、各指標に該当する割合が大きく異なる点にも留意する必要がある。交流する友人（10人以上）の割合や、スポーツや趣味への参加者の割合は、高齢者に比べ若年層では極端に低かった。健診受診率や、当然のことながら残歯数にも、年齢差は大きかった。これらには、年齢が直接もたらすものに加え、若年層で就業している者の割合（行政区により85-92%）が高齢者（包括区により15-35%）より高いことが影響しているものと考えられる。これらのことから、「健康格差縮小」のためには、若年層に適した対策とそれを浮き彫りにするための新たな指標の開発が必要になることも示唆された。

E．結　　論

若年層でも地区により地域診断指標に差があることが明らかになったことから、地域診断システムを応用することが、健康格差縮小に向け有用となる可能性があることが示唆された。一方、幸福感や健康度自己評価と関連する指標の一部は、若年層と高齢層では傾向が異なっており、若年層に適した新たな診断指標が必要になることも示唆された。このためには、充分なサンプルを確保したうえでさらなる検証が必要と考えられる。以上のことから、年齢層によるいくつかの相違に留意する必要はあるものの、若年層においても高齢者と同様に、データに基づく地域診断によって健康格差を見える化することの有用性が示された。

F．研究発表

とくになし

G．知的財産権の出願・登録状況

とくになし

参考資料１　使用した調査データの概要

１）若年層調査

対象地域：兵庫県Ａ市

調査対象者：平成 30 年8月1日時点で20歳以上 65 歳未満の方

対象者数：20,000 人

調査方法：郵送法

調査時点：平成 30年8月

回収結果（回収率）：6,666 票（33.3%）

２）Ａ市高齢者調査

対象地域：兵庫県Ａ市

調査対象者：平成 28 年 4 月 1 日時点で 65 歳以上である要介護（要支援）認定を受けていない一般高齢者

対象者数：15,978 人

調査方法：郵送法

調査時点：平成 28 年 11 月～平成 28 年 12 月

回収結果（回収率）：12,088 票（75,7%）

３）全国高齢者調査

対象地域：全国 19 都道府県 34 介護保険者 39 市町

調査対象者：平成28年４月1日時点で、65 歳以上である要介護（要支援）認定を受けていない一般高齢者

対象者数：279,661 人

調査方法：郵送法

調査時点：平成 28 年 10月～平成 28 年 12月

回収結果（回収率）：196,438 票（70.2%）.

参考資料２　地域診断指標間の相関（全体）

【若年層における　幸福感との相関順】	A市地域診断指標（赤字は若年独自項目）	若年層全体（A市）202005修正				高齢者全体（A市）				高齢者全体（全国）				若年と高齢者の比較（◎は、注目指標）
△は正相関0.3以上、▲は0.6以上。 ▽は、負相関-0.3以下、▼は-0.6以下。	若年層における幸福感との相関順	幸福感		健康感		幸福感		健康感		幸福感		健康感		
幸福感がある者の割合	幸福感	−	1	△	0.778	−	1	△	0.538	−	1	△	0.513	同傾向
地域活動の参加意向がある者の割合	地域活動	▲	0.931	▲	0.888		−0.044		0.004		0.201		0.155	◎若年層のみ強い相関
大学卒者割合	大学卒	▲	0.888	▲	0.928									
学習・教養サークル参加者(月1回以上)割合	学習・教養	▲	0.883	▲	0.686	△	0.318	△	0.39	△	0.377	▲	0.633	◎同傾向だが、若年層に顕著
交流する友人（10人以上）がいる者の割合	友人10超	▲	0.807	▲	0.663	△	0.439	△	0.442		0.273	△	0.305	◎同傾向だが、若年層に顕著
配偶者がいる人の割合	有配偶	▲	0.78	△	0.48									
主観的健康感が良い者の割合	健康感	▲	0.778	−	1	△	0.538	−	1	△	0.513	−	1	同傾向だが、若者層に顕著
趣味関係参加者割合(月1回以上)	趣味の会	▲	0.728	▲	0.736	△	0.578	△	0.62	▲	0.628	▲	0.759	◎同傾向だが、若年層に顕著
ボランティア活動への参加者割合(月1回以上)	ボランティア	▲	0.698	△	0.34		0.019		0.163	△	0.496	△	0.573	若年層に顕著だが、高齢者全国とは同傾向
スポーツ関係のグループ参加者割合(月1回以上)	スポーツ	▲	0.677	△	0.311	△	0.496	▲	0.633	▲	0.634	△	0.76	◎同傾向だが、若年層は幸福と高齢者は健康と相関強い
友人と会う頻度	友人頻度	▲	0.605	▲	0.743	△	0.307		0.252		−0.012		−0.223	同傾向だが、若年層に顕著。高齢者全国は逆向きの弱い相関。
常勤・正規職員者の割合	正規職員	△	0.572	△	0.577									
残業時間（20時間以上/月）	残業	△	0.538	△	0.564									
１年間に歯科検診を受けている者の割合	歯科検診	△	0.502	△	0.478									
週１日以上運動する人の割合	運動週1	△	0.449	△	0.551									
交流する友人（3～9人）がいる者の割合	友人3-9		0.253	△	0.52		−0.165		−0.096		−0.2	▽	−0.433	若年層のみ正の相関あり
飲酒者の割合	飲酒		0.202	▲	0.642									
就労していない者の割合	非就労		0.157		0.057	△	0.377	△	0.359		0.188	△	0.399	高齢者で弱い正の相関
仕事している人の割合	就労		0.157		−0.057									
特技や経験を他者に伝える活動参加者(月1回以上)割合	特技・経験		−0.034		−0.019	△	0.314		0.281	△	0.449	△	0.782	高齢者で弱い正の相関
休日勤務（5日以上/月）	休日勤務	▽	−0.322	▼	−0.607									
独居者割合	独居	▽	−0.335		0.021	▽	−0.457	▽	−0.539	▽	−0.47	▽	−0.376	◎幸福感は同傾向だが、若年層は健康感との相関なし
運動を１年以上連続している人の割合	運動1年	▽	−0.382	▼	−0.734									
町内会参加者(月1回以上)割合	町内会	▽	−0.396	▼	−0.813									
自営業・家業者の割合	自営	▽	−0.448		0.032									
孤食者割合	孤食	▽	−0.543		−0.054	▽	−0.475	▽	−0.542	▽	−0.378		−0.211	◎幸福感は同傾向だが、若年層は健康感との相関なし
未婚者割合	未婚	▽	−0.599	▽	−0.304									
5年以上喫煙している者の割合	喫煙5年超	▼	−0.727	▼	−0.789									
口腔機能低下者割合	口腔機能低下	▼	−0.733	▼	−0.617	▽	−0.323	▽	−0.446		−0.238	▼	−0.714	◎同傾向だが、若年層に顕著
健診(1年以内)未受診者割合	健診未受診	▼	−0.778	▽	−0.5	▽	−0.426	▽	−0.504		−0.098	▽	−0.37	同傾向
深夜労働（5日以上/月）	深夜労働	▼	−0.821	▽	−0.596									
喫煙者の割合	喫煙	▼	−0.878	▼	−0.705		−0.415		−0.34		−0.12		−0.233	◎同傾向だが若年層に顕著
経済的に苦しい者の割合	経済苦	▼	−0.884	▼	−0.778									
低所得者割合	低所得	▼	−0.892	▼	−0.712	▽	−0.563	▽	−0.56	▽	−0.355		−0.287	同傾向だが、若年層に顕著
交流する友人（0～2人）がいる者の割合	友人0-2	▼	−0.892	▼	−0.927	▽	−0.318	▽	−0.373		−0.116		0.017	◎同傾向だが、若年層に顕著
子どもの頃経済的に苦しかった者の割合	経済苦（子供）	▼	−0.919	▼	−0.811									
低学歴者割合	低学歴	▼	−0.922	▼	−0.706	▽	−0.558	▼	−0.631		−0.152	▽	−0.579	同傾向だが、若年層に顕著
残歯数19本以下の者の割合	残歯19以下	▼	−0.925	▼	−0.838	▽	−0.337	▽	−0.415	▽	−0.448	▼	−0.685	同傾向だが、若年層に顕著
↑濃色は、若年層で幸福感、健康度自己評価ともに相関係数±0.6超の指標														

研究成果の刊行に関する一覧表

書籍

著者氏名	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

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
Okabe D, Tsuji T, Hanazato M, Miyaguni Y, Asada N, Kondo K	Neighborhood Walkability in Relation to Knee and Low Back Pain in Older People: A Multilevel Cross-Sectional Study from the JAGES	Int J Environ Res Public Health	16(23)	4598	2019
Yokomichi H, Kondo K, Nagamine Y, Yamagata Z, Kondo N	Dementia risk by combinations of metabolic diseases and body mass index: Japan Gerontological Evaluation Study Cohort Study	J Diabetes Investig	11（1）	206-215	2020
Ide K, Tsuji T, Kanamori S, Jeong S, Nagamine Y, Kondo K	Social Participation and Functional Decline: A Comparative Study of Rural and Urban Older People, Using Japan Gerontological Evaluation Study Longitudinal Data	Int J Environ Res Public Health	17(2)	617	2020
Yamada K, Kubota Y, tabuchi t, shirai K, Iso H, Kondo N, Kondo K	A prospective study of knee pain, low back pain, and risk of dementia: the JAGES project.	Scientific Reports	9(1)	10690	2019
Momosaki R, Nishioka S, Wakabayashi H, Kojima K, Maeda K, Tani Y, Hiroshi S, Norimichi S, Masamichi H, Katsunori K	Association between Food Store Availability and the Incidence of Functional Disability among Community-Dwelling Older Adults: Results from the Japanese Gerontological Evaluation Cohort Study.	Nutrients	11(10)	2369	2019
Watanabe R, Kondo K, Saito T, Tsuji T, Hayashi T, Ikeda T, Tokunori T	Change in Municipality-Level Health-Related Social Capital and Depressive Symptoms: Ecological and 5-Year Repeated Cross-Sectional Study from the JAGES	International Journal of Environmental Research and Public Health	16(11)	2038	2019
Kusama T, Aida J, Yamamoto T, Kondo K, Osaka K	Infrequent Denture Cleaning Increased the Risk of Pneumonia among Community-dwelling Older Adults: A Population-based Cross-sectional Study	Sci Rep	9(1)	13734	2019

Takasugi T, Tsuji T, Nagamine Y, Miyaguni Y, Kondo K	Socio-economic status and dementia onset among older Japanese: A 6-year prospective cohort study from the Japan Gerontological Evaluation Study	Int J Geriatr Psychiatry	34(11)	1642-50	2019
Yamakita M, Kanamori S, Kondo N, Ashida T, Fujiwara T, Tsuji T, Kondo K	Association between childhood socioeconomic position and sports group participation among Japanese older adults: A cross-sectional study from the JAGES 2010 survey	Prev Med Rep	18	101065	2020

令和　2年　3月　31日

厚生労働大臣
(~~国立医薬品食品衛生研究所長~~)　殿
(~~国立保健医療科学院長~~)

機関名　　国立長寿医療研究センター
所属研究機関長　職　名　　理事長
氏　名　荒 井　秀 [redacted]

次の職員の令和元年度厚生労働科学研究費の調査研究における、倫理審査状況及び利益相[redacted]ては以下のとおりです。

1．研究事業名　循環器疾患・糖尿病等生活習慣病対策総合研究事業

2．研究課題名　社会経済格差による生活習慣課題への対応方策立案に向けた社会福祉・疫学的研究

3．研究者名　(所属部局・職名)　老年学評価研究部　　部長

(氏名・フリガナ)　近 藤　克 則　　(コンドウ　カツノリ)

4．倫理審査の状況

	該当性の有無	左記で該当がある場合のみ記入 (※1)		
	有　無	審査済み	審査した機関	未審査 (※2)
ヒトゲノム・遺伝子解析研究に関する倫理指針	□　■	□		□
遺伝子治療等臨床研究に関する指針	□　■	□		□
人を対象とする医学系研究に関する倫理指針 (※3)	■　□	■	国立長寿医療研究センター	□
厚生労働省の所管する実施機関における動物実験等の実施に関する基本指針	□　■	□		□
その他、該当する倫理指針があれば記入すること (指針の名称：　　)	□　■	□		□

(※1) 当該研究者が当該研究を実施するに当たり遵守すべき倫理指針に関する倫理委員会の審査が済んでいる場合は、「審査済み」にチェックし一部若しくは全部の審査が完了していない場合は、「未審査」にチェックすること。

その他（特記事項）

(※2) 未審査に場合は、その理由を記載すること。
(※3) 廃止前の「疫学研究に関する倫理指針」や「臨床研究に関する倫理指針」に準拠する場合は、当該項目に記入すること。

5．厚生労働分野の研究活動における不正行為への対応について

研究倫理教育の受講状況	受講 ■　未受講 □

6．利益相反の管理

当研究機関におけるＣＯＩの管理に関する規定の策定	有 ■　無 □(無の場合はその理由:　　)
当研究機関におけるＣＯＩ委員会設置の有無	有 ■　無 □(無の場合は委託先機関:　　)
当研究に係るＣＯＩについての報告・審査の有無	有 ■　無 □(無の場合はその理由:　　)
当研究に係るＣＯＩについての指導・管理の有無	有 □　無 ■(有の場合はその内容：　　)

(留意事項)　・該当する□にチェックを入れること。
・分担研究者の所属する機関の長も作成すること。

2020年 3月27日

厚生労働大臣 殿

機関名　日本福祉大学

所属研究機関長　職　名　学長

氏　名　児 玉 善 郎 [redacted]

次の職員の令和元年度厚生労働科学研究費の調査研究における、倫理審査状況及び利益相反等の管理については以下のとおりです。

１．研究事業名　循環器疾患・糖尿病等生活習慣病対策総合研究事業

２．研究課題名　社会経済格差による生活習慣課題への対応方策立案に向けた社会福祉・疫学的研究

３．研究者名　（所属部局・職名）　社会福祉学部・准教授

（氏名・フリガナ）　斉藤雅茂・サイトウマサシゲ

４．倫理審査の状況

	該当性の有無		左記で該当がある場合のみ記入（※1）		
	有	無	審査済み	審査した機関	未審査（※2）
ヒトゲノム・遺伝子解析研究に関する倫理指針	□	☑	□		□
遺伝子治療等臨床研究に関する指針	□	☑	□		□
人を対象とする医学系研究に関する倫理指針（※3）	□	☑	□		□
厚生労働省の所管する実施機関における動物実験等の実施に関する基本指針	□	☑	□		□
その他、該当する倫理指針があれば記入すること（指針の名称：　　）	□	☑	□		□

（※1）当該研究者が当該研究を実施するに当たり遵守すべき倫理指針に関する倫理委員会の審査が済んでいる場合は、「審査済み」にチェックし一部若しくは全部の審査が完了していない場合は、「未審査」にチェックすること。

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（※2）未審査に場合は、その理由を記載すること。
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５．厚生労働分野の研究活動における不正行為への対応について

研究倫理教育の受講状況	受講 ☑　未受講 □

６．利益相反の管理

当研究機関におけるＣＯＩの管理に関する規定の策定	有 ☑　無 □（無の場合はその理由：　　）
当研究機関におけるＣＯＩ委員会設置の有無	有 ☑　無 □（無の場合は委託先機関：　　）
当研究に係るＣＯＩについての報告・審査の有無	有 ☑　無 □（無の場合はその理由：　　）
当研究に係るＣＯＩについての指導・管理の有無	有 □　無 ☑（有の場合はその内容：　　）

（留意事項）　・該当する□にチェックを入れること。
・分担研究者の所属する機関の長も作成すること。

令和　2年　3月　31日

厚生労働大臣
(~~国立医薬品食品衛生研究所長~~)　殿
(~~国立保健医療科学院長~~)

機関名　　国立長寿医療研究
所属研究機関長　職　名　　理事長
氏　名　荒井　秀

次の職員の令和元年度厚生労働科学研究費の調査研究における、倫理審査状況及び利益相反
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3．研究者名　(所属部局・職名)　老年社会科学研究部　社会参加・社会支援研究室長

(氏名・フリガナ)　村田　千代栄　(ムラタ　チヨエ)

4．倫理審査の状況

	該当性の有無		左記で該当がある場合のみ記入 (※1)		
	有	無	審査済み	審査した機関	未審査 (※2)
ヒトゲノム・遺伝子解析研究に関する倫理指針	□	■	□		□
遺伝子治療等臨床研究に関する指針	□	■	□		□
人を対象とする医学系研究に関する倫理指針 (※3)	■	□	■	国立長寿医療研究センター	□
厚生労働省の所管する実施機関における動物実験等の実施に関する基本指針	□	■	□		□
その他、該当する倫理指針があれば記入すること (指針の名称：　　)	□	■	□		□

(※1) 当該研究者が当該研究を実施するに当たり遵守すべき倫理指針に関する倫理委員会の審査が済んでいる場合は、「審査済み」にチェックし一部若しくは全部の審査が完了していない場合は、「未審査」にチェックすること。

その他（特記事項）

(※2) 未審査に場合は、その理由を記載すること。
(※3) 廃止前の「疫学研究に関する倫理指針」や「臨床研究に関する倫理指針」に準拠する場合は、当該項目に記入すること。

5．厚生労働分野の研究活動における不正行為への対応について

研究倫理教育の受講状況	受講 ■　未受講 □

6．利益相反の管理

当研究機関におけるＣＯＩの管理に関する規定の策定	有 ■　無 □(無の場合はその理由:　　)
当研究機関におけるＣＯＩ委員会設置の有無	有 ■　無 □(無の場合は委託先機関:　　)
当研究に係るＣＯＩについての報告・審査の有無	有 ■　無 □(無の場合はその理由:　　)
当研究に係るＣＯＩについての指導・管理の有無	有 □　無 ■(有の場合はその内容：　　)

(留意事項)　・該当する□にチェックを入れること。
・分担研究者の所属する機関の長も作成すること。

令和　2年　3月　31日

厚生労働大臣
（~~国立医薬品食品衛生研究所長~~）　殿
（~~国立保健医療科学院長~~）

機関名　　同志社大学
所属研究機関長　職　名　　学長
氏　名　　松 岡　敬

次の職員の令和元年度厚生労働科学研究費の調査研究における、倫理審査状況及び利益相反等の管理については以下のとおりです。

１．研究事業名　　循環器疾患・糖尿病等生活習慣病対策総合研究事業

２．研究課題名　　社会経済格差による生活習慣課題への対応方策立案に向けた社会福祉・疫学的研究

３．研究者名　　（所属部局・職名）　商学部　　教授

（氏名・フリガナ）　佐 々 木　一 郎　　（ササキ　イチロウ）

４．倫理審査の状況

	該当性の有無		左記で該当がある場合のみ記入（※1）		
	有	無	審査済み	審査した機関	未審査（※2）
ヒトゲノム・遺伝子解析研究に関する倫理指針	□	■	□		□
遺伝子治療等臨床研究に関する指針	□	■	□		□
人を対象とする医学系研究に関する倫理指針（※3）	□	■	□		□
厚生労働省の所管する実施機関における動物実験等の実施に関する基本指針	□	■	□		□
その他、該当する倫理指針があれば記入すること（指針の名称：　　）	□	■	□		□

（※1）当該研究者が当該研究を実施するに当たり遵守すべき倫理指針に関する倫理委員会の審査が済んでいる場合は、「審査済み」にチェックし一部若しくは全部の審査が完了していない場合は、「未審査」にチェックすること。

その他（特記事項）

（※2）未審査に場合は、その理由を記載すること。
（※3）廃止前の「疫学研究に関する倫理指針」や「臨床研究に関する倫理指針」に準拠する場合は、当該項目に記入すること。

５．厚生労働分野の研究活動における不正行為への対応について

研究倫理教育の受講状況	受講 ■　　未受講 □

６．利益相反の管理

当研究機関におけるＣＯＩの管理に関する規定の策定	有 ■　無 □（無の場合はその理由：　　）
当研究機関におけるＣＯＩ委員会設置の有無	有 ■　無 □（無の場合は委託先機関：　　）
当研究に係るＣＯＩについての報告・審査の有無	有 ■　無 □（無の場合はその理由：　　）
当研究に係るＣＯＩについての指導・管理の有無	有 □　無 ■（有の場合はその内容：　　）

（留意事項）　・該当する□にチェックを入れること。
・分担研究者の所属する機関の長も作成すること。