Population Aging at the Local Level and Health at Older Ages in Japan

James M. Raymo
Eric Vogelsang
Jersey Liang
Erika Kobayashi
Research Questions

1) Do people living in older areas age differently?
2) If so, how?
3) If so, why?
Motivation

• Unprecedented pace of population aging in Japan
• Extreme population aging at local level
• Limited attention to the implications of population aging at the local level
• Theoretical reasons to believe that local area age structure is important
• Increased (renewed) interest in contextual/environmental influences on health
Overview

• Population aging in Japan
• Posited linkages between age structure and individual health
• Data
• Results
In Japan, a rural village on extinction's edge

By Norimitsu Onishi
Published: Tuesday, April 25, 2006

OGAMA, Japan — This mountain village on the West Coast, withered to eight aging residents, concluded recently that it could no longer go on. So, after months of anguish, the villagers settled on a drastic solution: selling all of Ogama to an industrial waste company from Tokyo, which will turn it into a landfill.
Low Subsidies, Aging Plague Rural Japan

By HANS GREIMEL
The Associated Press
Sunday, March 4, 2007; 2:04 PM

YUBARI, Japan -- When the last coal mine in Yubari closed down in 1990, city elders thought pumping tax money into an amusement park, hall of fossils, ski resort and robot museum would keep this remote snowbound town of 13,000 people afloat and on the map.
Rural aging in the news

SPECIAL REPORT

THE AGE-OLD PROBLEM

The unprecedented quake and tsunami pummelled an area of Japan that has come to epitomise the country’s demographic dilemma of a shrinking and greying population. Towns in the northeast have been losing young people and industry for years, leaving behind an increasing number of the elderly.
Following the earthquake and tsunami, Rikuzentakata faces Japan’s age-old problem

More than a third of the Japanese town’s population is 65 and over, and what to do with such shattered coastal towns will be one of the key issues of the rebuilding effort and a test of how the nation handles its ageing challenges
By Yoko Kubota / Reuters, RIKUZENTAKATA, JAPAN
Tue, Mar 29, 2011 - Page 9

‘Too Late’ for Some Tsunami Victims to Rebuild in Japan
By MICHAEL WINES
KESENNUMA, Japan — A week after the tsunami obliterated most of this northern Japanese city’s seafront and not a little of its inland, the first handful of shopkeepers and their employees were outdoors shoveling mud and hauling wreckage from their businesses, signs of rebirth after this region’s worst catastrophe in memory.

Kunio Imakawa, a 75-year-old barber, was not among them.
Projected change in Japan’s population age structure

- 20% of the population is expected to be in the 0-14 age group.
- 41% of the population is expected to be in the 15-64 age group.
- 39% of the population is expected to be 65+ years old.
Another view
Distribution of municipalities by %65+ in 2005
Distribution of municipalities by %65+ in 2035

- <10%: 9%
- 10-20%: 7%
- 20-30%: 0%
- 30-40%: 0%
- 40-50%: 9%
- 50%: 34%
- >50%: 30%
Motivations II

• Strong theoretical reason to expect local area age structure to matter
• Evidence that elderly may be particularly sensitive to environment
• Policy relevance
  – identify “at-risk” areas
  – identify beneficial/detrimental aspects of context
Age Structure

Compositional Aggregation of Individual Differences

Contextual: Physical Services
Built Environment
Toxins

Contextual: Social/Economic
Collective Efficacy
Social Capital
Social Engagement

Health at Older Ages

Compositional linkages

• Elderly living in older areas:
  – tend to be older
  – tend to be less educated
  – may have lower income/wealth
  – may be far from family

• But they are also more likely to:
  – coreside with children
  – be employed
Contextual (physical) linkages

• Older areas are likely to:
  – be less economically vibrant
  – be more isolated
  – have fewer amenities and services

• But they are also more likely to:
  – be crowded
  – be less polluted
  – attract more services/business targeted to elderly
Contextual (social) linkages

• Older areas may also differ in terms of:
  – social ties, interaction
  – integration/isolation
  – cohesion/collective efficacy
Age Structure (% elderly)

Compositional (age, education, employment, etc.)

Contextual: Physical

Health at Older Ages (SRH, CESD, Functioning)

Contextual: Social/Economic (net migration) (per capita income)

Why Japan?

• Forerunner with respect to population aging
• Healthy
• Distinctive patterns of regional aging – limited geographic mobility
• Potential source of insight for other rapidly aging societies in Asia
Data

• National Survey of Japanese Elderly
• Panel study of 60+ population
• Waves 1-6 (1987-2002)

• Census data on age structure
  – % population age 65+

• Data on population movement and taxable income
  – Gross migration
  – Per capita income
## Correlation of Contextual Variables

<table>
<thead>
<tr>
<th></th>
<th>Mean % elderly</th>
<th>Mean gross migration</th>
<th>Mean per capita income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean % elderly</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean gross migration</td>
<td>-0.5199</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Mean per capita income</td>
<td>-0.5753</td>
<td>0.6218</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
Health outcomes

• Self-rated health (range: 1-5, poor– excellent)
• CES-D (range 0-14)
  – depressed, lonely, sad, no appetite, everything an effort, bad sleep, didn’t feel like doing anything
  – hardly every (0) – often (2)
• Functional limitations
  – walking, grasping, lifting, reaching, stooping
  – no difficulty (0), any difficulty (1)
Health trajectories

• Is age structure associated with better/worse health?

• Is age structure associate with change in health across older ages?
  – Successful aging
  – Healthy life expectancy
  – Disability free life
Trends in age structure 1987-2002

Pct. of municipalities

- <10%
- 10-15%
- 15-20%
- <=20%

1987: 33, 24, 16, 3
1990: 46, 24, 24, 6
1993: 43, 16, 32, 9
1996: 39, 8, 33, 19
1999: 28, 3, 40, 29
2002: 20, 0, 40, 40
Hierarchical Data Structure

Area 1
- Person A
  - 1 2 3 4 5 6
- Person B
  - 1 2 3 4 5

Area 2
- Person A
  - 1 2 3 4 5 6
- Person B
  - 1 2 3
Longitudinal (Growth Curve) Models

• Level 1 Model (repeated-observations model):
  \[ H_{tia} = \pi_{0ia} + T_{tia} \pi_{1ia} + \varepsilon_{tia} \]

• Level 2 Model (person-level model):
  \[ \pi_{0ia} = \beta_{00a} + r_{0ia} \]
  \[ \pi_{1ia} = \beta_{10a} + r_{1ia} \]

• Level 3 Model (municipality-level model)
  \[ B_{00a} = \gamma_{000} + \gamma_{001} E_{100a} \]
  \[ B_{10a} = \gamma_{100} + \gamma_{101} \bar{E}_{10a} \]

Limit to those with at least two observations
Assume linear trajectories (for now)
Assume linear relationship between age structure and health (for now)
No random effects at level 3 – really a two-level model
Longitudinal (Growth Curve) Models

• Level 1 Model (repeated-observations model):
  \[- H_{tia} = \pi_{0ia} + T_{tia} \pi_{1ia} + \varepsilon_{tia} \]

• Level 2 Model (person-level model):
  \[- \pi_{0ia} = \beta_{00a} + A_{0ia} \beta_{01a} + Y_{0ia} \beta_{02a} + r_{0ia} \]
  \[- \pi_{1ia} = \beta_{10a} + r_{1ia} \]

• Level 3 Model (municipality-level model)
  \[- B_{00a} = \gamma_{000} + \gamma_{001} E_{100a} \]
  \[- B_{01a} = \gamma_{010} \]
  \[- B_{02a} = \gamma_{020} \]
  \[- B_{10a} = \gamma_{100} + \gamma_{101} E_{10a} \]
Longitudinal (Growth Curve) Models

• Level 1 Model (repeated-observations model):
  \[- H_{tia} = \pi_{0ia} + T_{tia} \pi_{1ia} + \varepsilon_{tia} \]

• Level 2 Model (person-level model):
  \[- \pi_{0ia} = \beta_{00a} + A_{0ia} \beta_{01a} + Y_{0ia} \beta_{02a} + r_{0ia} \]
  \[- \pi_{1ia} = \beta_{10a} + r_{1ia} \]

• Level 3 Model (municipality-level model)
  \[- B_{00a} = \gamma_{000} + \gamma_{001} E_{100a} + \gamma_{002} PM1_{00a} + \gamma_{003} INC1_{00a} \]
  \[- B_{01a} = \gamma_{010} \]
  \[- B_{02a} = \gamma_{020} \]
  \[- B_{10a} = \gamma_{100} + \gamma_{101} E_{10a} + \gamma_{102} PM_{00a} + \gamma_{103} INC_{00a} \]
## Results

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-rated health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%65+ (intercept)</td>
<td>+</td>
<td>NS</td>
<td>+</td>
</tr>
<tr>
<td>%65+ (slope)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>CES-D (&gt;1)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%65+ (intercept)</td>
<td>NS</td>
<td>+</td>
<td>NS</td>
</tr>
<tr>
<td>%65+ (slope)</td>
<td>NS</td>
<td>NS</td>
<td>-</td>
</tr>
<tr>
<td><strong>Fun. Lim. (&gt;0)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%65+ (intercept)</td>
<td>NS</td>
<td>+</td>
<td>NS</td>
</tr>
<tr>
<td>%65+ (slope)</td>
<td>NS</td>
<td>-</td>
<td>NS</td>
</tr>
</tbody>
</table>
Self-rated health: Baseline

The graph shows the predicted values of self-rated health across different age groups for Tama-shi, Kochi-shi, and Misato-cho. The values decrease with increasing age, indicating a decline in self-rated health as people age.
Self-rated health: w/covariates

Predicted value of self-rated health vs Age for different areas:
- Tama-shi
- Kochi-shi
- Misato-cho
Self-rated health: w/contextual covariates

Predicted value of self-rated health

Age

- Tama-shi
- Kochi-shi
- Misato-cho
CES-D: w/covariates

Predicted probability of CESD>1

Age

Tama-shi  Kochi-shi  Misato-cho
CES-D: w/ contextual covariates

**Graph:**
- **Predicted probability of CESD>1**
- **Age**
- **Legend:**
  - Green line: Tama-shi
  - Purple line: Kochi-shi
  - Blue line: Misato-cho

**Graph Description:**
- The graph shows the predicted probability of CESD>1 against age for three different areas: Tama-shi, Kochi-shi, and Misato-cho.
- The probability increases with age for all three areas.

**Data Points:**
- Tama-shi: The predicted probability is relatively low across all ages.
- Kochi-shi: The predicted probability is higher than Tama-shi and increases more steadily with age.
- Misato-cho: The predicted probability is the highest among the three and also increases steadily with age.
Functional Limitations: Baseline

![Graph showing predicted probability of functional limitation (FL) over age for Tama-shi, Kochi-shi, and Misato-cho.](image)
Functional Limitations: w/covariates

Predicted probability of FL limitation > 0

Age

Tama-shi  Kochi-shi  Misato-cho
Functional Limitations: w/ contextual covariates

Predicted probability of FL limitation > 0

Age

Tama-shi
Kochi-shi
Misato-cho
Conclusions

• Limited differences by age structure in baseline health
• Large differences in health change at older ages
• SRH declines more rapidly in older areas
  – Not explained by composition or context
• P(CES-D>1) increases less rapidly in older areas
  – Partially reflects differences in migration/stability
• P(FL>0) increases less rapidly in older areas
  – Explained by local area income
Limitations & next steps

• Incorporate other measures of context
  – access to health care
  – environment
• Consider non-linear trajectories
• Incorporate residential history data
• Account for attrition to death and non-response
• Consider role of neighboring municipalities – spatial regression models
• Consider heterogeneity in shape of trajectories