Neighborhood Deprivation, Rurality and Impaired Kidney Function in Japan: A Nationwide Cohort Study

Nana ISHIMURA

Kyoto University, Kyoto, Japan

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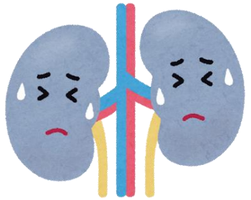
Unresolved Issue:

Health disparities in CKD (Chronic Kidney Disease)



✓CKD is one of the major public health concerns –affecting 850 million globally

✓“Socioeconomic disparities in CKD” have been reported (e.g. Income, Education),

but Limited data

–**Area-level** Socioeconomic disparities

–**Countries with UHC** (Universal Health Coverage), especially from **Japan**

Morton RL, et al. *Nephrol Dial Transplant*. 2016;31(1):46-56.
Grant CH, et al. *Clin Kidney J*. 2023;16(7):1081-1091.

➢Are there any contextual effects in the residential area?

1. Neighborhood deprivation
2. Rurality

Extensive health care system

- **UHC** with Long history
- Mandatory annual health **check-up**
- **Public financial assistance** for high-cost medical care and Kidney replacement therapy

Methods

Covering 40 million people =
1/3 of total population in Japan

Population

- The Japan Health Insurance Association (JHIA): the biggest public insurer
- Insured adults (Not dependents) taking health check-ups in 2015
- Multiple kidney function measurements during the study period (FY2015-FY2022)

FY (fiscal year)

Exposure

- (a) Neighborhood deprivation: **Area deprivation index (ADI)** deciles
- (b) Rurality: **Rurality index for Japan (RIJ)** deciles

【Postal-code (5 of 7-digit) level】

What is ADI, and RIJ?

ADI (Area Deprivation Index)

= Composite indicator to estimate the **poverty level of each areas** calculated by weighting eight census area indicators (below)

ADI (Japanese ver.) =
k*(2.99∗old couple households+7.57∗old single households+
17.4∗single-mother households+ 2.22∗rent houses+
4.03∗sales and service workers+ 6.05∗agricultural workers+
5.38∗blue caller workers+ 18.3∗unemployment rate)

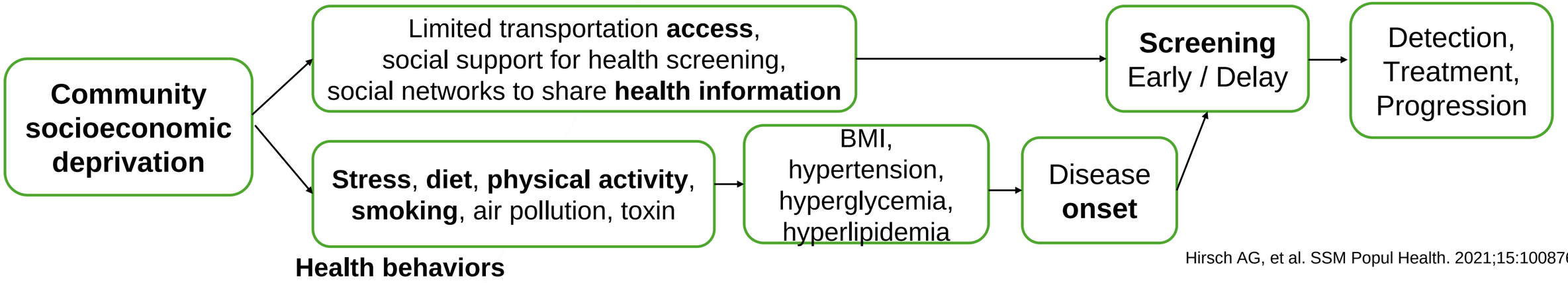
Nakaya T, Ito Y. *The Atlas of Health Inequalities in Japan.* Springer 2019

RIJ (Rurality Index for Japan)

= Composite indicator to estimate the **rurality** in Japan in terms of **access to medical care** calculated by weighting four area indicators (below)

RIJ =
population density∗(−0.3)+
direct distance to the nearest secondary or tertiary hospital∗0.46+
remote island∗0.47+special heavy snowfall areas∗0.3

Kaneko M, et al. *BMJ Open.* 2023;13(6):e068800.



Hirsch AG, et al. SSM Popul Health. 2021;15:100876.

Methods

Outcome

(i) **Rapid CKD progression (eGFR decline > 5 ml/min/1.73m^2/year)**

(ii) **Initiation of KRT (dialysis or kidney transplantation)**

KDIGO 2012 Clinical Practice Guideline
for the Evaluation and Management of Chronic Kidney Disease

KRT (Kidney Replacement Therapy)

Statistical Analysis

(i) Logistic regression model

(ii) Cox proportional hazards regression model

Confounders

Model 1: Age, Sex
Model 2: Model 1 + Smoking
Model 3: Model 2 + Comorbidities, Health Check-up data
Model 4: Model 3 + Income

} Potential mediators

→ Individual Socioeconomic status

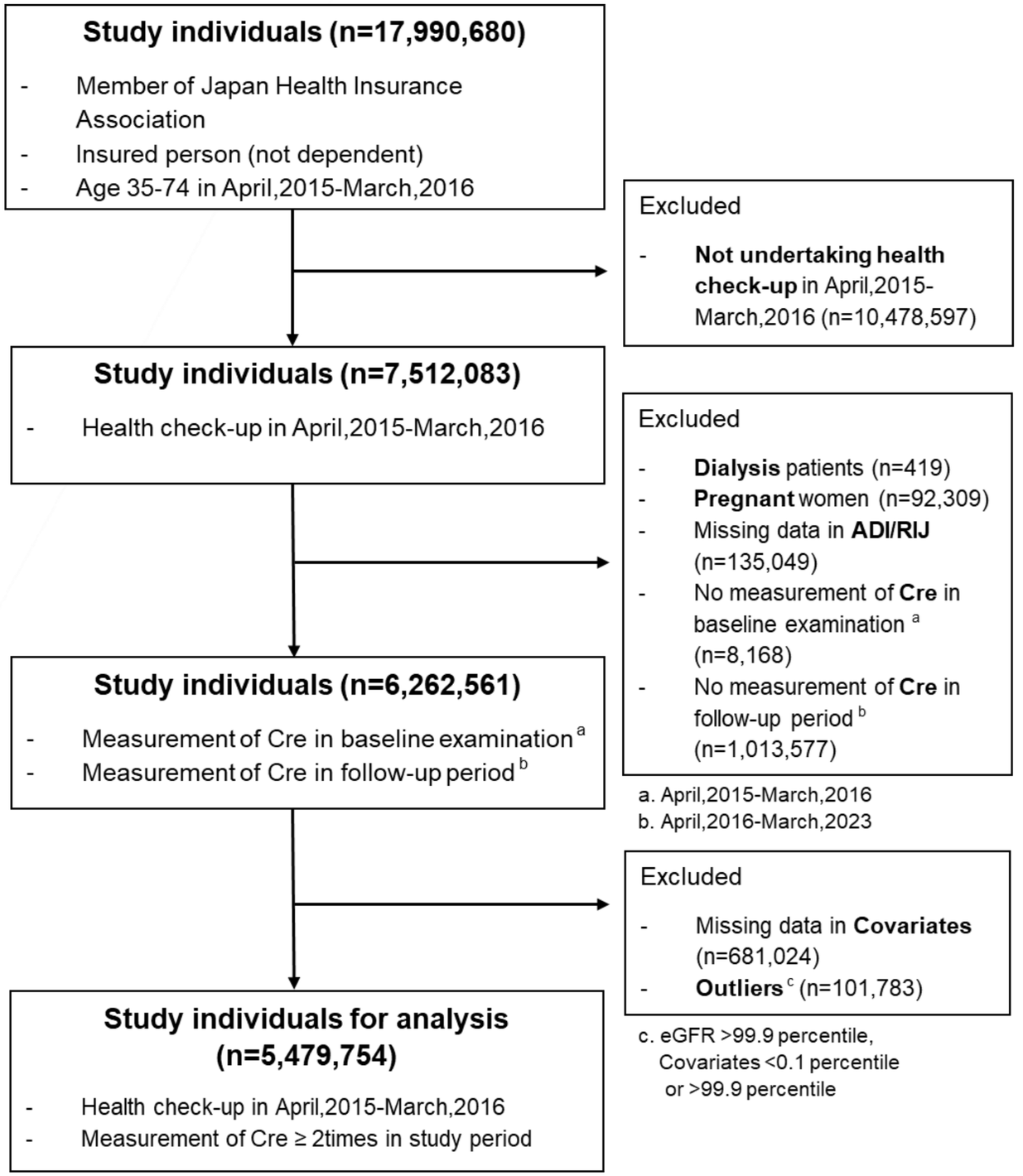
Results

Number of events

(i) Rapid CKD progression: **301,249** cases (**5.5** %)

(ii) KRT initiation (dialysis or transplantation):

6,417 cases (**0.12** %)



Results

Rich ⇔ Poor Urban ⇔ Rural

	Overall	ADI decile 1 (Least deprived)	ADI decile 10 (Most deprived)	RIJ decile 1 (Close to hospital)	RIJ decile 10 (Distant to hospital)
Number	5,479,754	567,141	545,480	548,065	547,612
Income, JPY/month, mean (SD)	387,226 (271,541)	458,775 (373,932)	340,628 (213,765)	456,465 (357,187)	327,527 (193,243)
Age, mean (SD)	**49.3** (9.3)	**48.6** (9.4)	**49.8** (9.2)	**48.7** (9.4)	**49.8** (9.1)
Sex, %, men	**66.3**	**67.7**	**64.0**	**66.6**	**62.7**
Smoking, %	**34.3**	**32.1**	**36.4**	**33.8**	**34.8**
BMI, kg/m^2, mean (SD)	23.3 (3.7)	23.2 (3.6)	23.6 (3.8)	23.2 (3.7)	23.4 (3.7)
Waist circumference, cm, mean (SD)	82.5 (9.9)	82.5 (9.9)	82.9 (10.1)	82.5 (10.0)	82.3 (9.9)

Results

Rich ⇔ Poor Urban ⇔ Rural

	Overall	ADI decile 1 (Least deprived)	ADI decile 10 (Most deprived)	RIJ decile 1 (Close to hospital)	RIJ decile 10 (Distant to hospital)
eGFR, ml/min/1.73m^2, mean (SD)	**79.7** (14.2)	**79.3** (13.9)	**80.0** (14.6)	**79.5** (14.1)	**80.0** (14.3)
Hb, g/dL, mean (SD)	14.5 (1.5)	14.5 (1.5)	14.5 (1.5)	14.4 (1.4)	14.4 (1.5)
Systolic BP, mmHg, mean (SD)	**122.4** (16.9)	**120.6** (16.7)	**124.0** (17.3)	**120.0** (16.8)	**123.6** (17.0)
LDL-C, mg/dL, mean (SD)	124.3 (31.5)	123.6 (31.5)	124.3 (31.7)	123.4 (31.7)	123.6 (31.3)
HDL-C, mg/dL, mean (SD)	62.0 (16.5)	62.1 (16.5)	61.8 (16.5)	62.1 (16.6)	62.6 (16.6)
TG, mg/dL, mean (SD)	113.3 (85.4)	112.7 (84.7)	115.4 (88.5)	113.8 (87.2)	113.5 (86.2)
Glucose, mg/dL, mean (SD)	**97.7** (19.0)	**96.8** (18.4)	**98.6** (19.8)	**96.9** (18.7)	**97.7** (19.0)
UA, mg/dL, mean (SD)	5.6 (1.4)	5.6 (1.4)	5.6 (1.4)	5.6 (1.4)	5.5 (1.4)
Comorbidity					
Cancer, %	2.6	2.7	2.7	2.7	2.7
Cardiovascular disease, %	**8.5**	**8.5**	**9.0**	**8.5**	**8.7**
Diabetes, %	**3.5**	**3.2**	**4.0**	**3.1**	**3.5**
Dyslipidemia, %	**17.5**	**16.4**	**18.1**	**16.3**	**19.5**
Hypertension, %	**18.0**	**16.3**	**20.1**	**16.0**	**19.9**
Hyperuricemia, %	5.2	5.2	5.3	5.3	5.3

Results

(i) Risk of rapid CKD progression			Model 1: Age, Sex	Model 2: 1 + Smoking	Model 3: 2 + Comorbidities, Check-ups	Model 4: 3 + Income
5-digit postal code level			OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
ADI	Decile1 (least deprived)	Rich	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)
	Decile10 (most deprived)	Poor	**0.98** (0.97-1.00)	**0.96** (0.94-0.97)	**0.94** (0.92-0.95)	**0.89** (0.87-0.90)
RIJ	Decile1 (Close to hospital)	Urban	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)
	Decile10 (Distant to hospital)	Rural	**0.84** (0.83-0.85)	**0.83** (0.82-0.84)	**0.81** (0.80-0.83)	**0.76** (0.75-0.78)

(ii) Risk of KRT initiation			Model 1: Age, Sex	Model 2: 1 + Smoking	Model 3: 2 + Comorbidities, Check-ups	Model 4: 3 + Income
5-digit postal code level			HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)
ADI	Decile1 (least deprived)	Rich	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)
	Decile10 (most deprived)	Poor	**1.25** (1.12-1.40)	**1.26** (1.13-1.41)	**1.01** (0.90-1.13)	**0.96** (0.86-1.08)
RIJ	Decile1 (Close to hospital)	Urban	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)	**1.0** (Ref)
	Decile10 (Distant to hospital)	Rural	**0.98** (0.87-1.10)	**0.98** (0.88-1.10)	**0.99** (0.89-1.11)	**0.94** (0.84-1.06)

OR: Odds Ratio, HR: Hazard Ratio

Discussion

Summary of Findings

- Those living in the **most deprived areas** showed a slightly **higher** risk of KRT initiation, but this risk was eliminated by adjusting for potential mediators: comorbidities and income.
- Those living in **remote areas** showed the **same** or **lower** risks of CKD progression.
- **We found no strong association** between area-level socioeconomic status and impaired kidney function in Japan.


JAMA Health Forum

Original Investigation

Income Level and Impaired Kidney Function Among Working Adults in Japan

Nana Ishimura, MD; Kosuke Inoue, MD, PhD; Shiko Maruyama, MA, PhD; Sayaka Nakamura, MA, PhD; Naoki Kondo, MD, PhD

In the same population, we previously found a **strong dose-response association** between **"Individual Income"** and impaired kidney function.
the risk for rapid CKD progression: adjusted OR (1^{st} vs 10^{th} decile), **1.70** (95% CI, 1.67-1.73),
and the risk for KRT initiation: adjusted HR (1^{st} vs 10^{th} decile), **1.65** (95% CI, 1.47-1.86).

Ishimura N, et al. JAMA Health Forum. 2024;5(3):e235445.

Discussion

Previous studies

- Although the association between area-level SES and CKD is complex, **most studies have shown an independent association** between neighborhood deprivation or remoteness, and CKD progression/end-stage kidney disease.

Akrawi DS, et al. *Eur J Intern Med*. 2014;25(9):853-859.
Weldegiorgis M, et al. *Nephrol Dial Transplant*. 2020;35(9):1562-1570.

Potential Mechanisms

- Different relationships depending on the participant's **baseline CKD stage**.

Bello AK, et al. C*lin J Am Soc Nephrol*. 2008;3(5):1316-1323.

- Not included many primary industry workers (≒ blue workers) in this insurance, **the health status in remote areas was overestimated**.
- **Japanese extensive health care system** ensures a certain degree of equity.

Limitations

- Selection bias
  - –only included the insured individuals taking **health check-ups**, and **attrition bias**
- Information bias
  - –measurement error of exposures (based on **postal code, not on census tract**) and outcomes
- Residual confounding
- Limited generalizability

Conclusion

- There was no strong association between neighborhood deprivation, rurality and impaired kidney function among working adults in Japan.
- It is necessary to evaluate socioeconomic disparities by region and society.
- To prevent CKD and reduce disparities, it might be important to focus on the socioeconomic status of individuals rather than their residential areas.