Impact of smoking/drinking prevalence on association between areal-level socioeconomic status and cancer mortality in Japan: A nationwide cross-sectional ecological study

P3-D5

Hiroshi Tsuge[1,3], Yuriko Koyanagi[1], Yukari Taniyama[1], Masanori Kawaura[1], Rina Yoshida[2], Mayu Furuhashi[1], Isao Oze[1], Takahiro Otani[3], Tomoki Nakaya[4], Kunihiko Takahashi[5], Rui Yamaguchi[1], Keitaro Matsuo[1], Hidemi Ito[1]

[1] Aichi Cancer Center Research Institute [2] Nagoya University [3] Nagoya City University [4] Tohoku University [5] Tokyo Medical and Dental University

Background Regional socioeconomic disparities are known to affect cancer incidence and mortality. (Ueda et al. 2005)
It is also known that smoking and drinking rates are higher in poorer areas. (Tanaka et al. 2020, Fukuda et al. 2005)
Smoking and drinking are risks for many cancers and may mediate the impact of socioeconomic disparities on cancer mortality.
In this study, we examined the impact of areal deprivation index by municipality on cancer mortality by conducting a spatial mediation analysis using smoking and drinking rates.

Method

The Areal Deprivation Index (ADI) for each municipality was calculated from the census data and normalized.

ADI= 2.99xProportion of elderly married couples + 7.57xProportion of elderly single-person households + 17.4xProportion of single-mother households + 2.22xProportion of households living in rental housing + 4.03xProportion of occupations (service/sales) + 6.05xProportion of occupations (agriculture) + 5.38xProportion of occupations (blue-collar) + 18.3xProportion of occupations (unemployed)

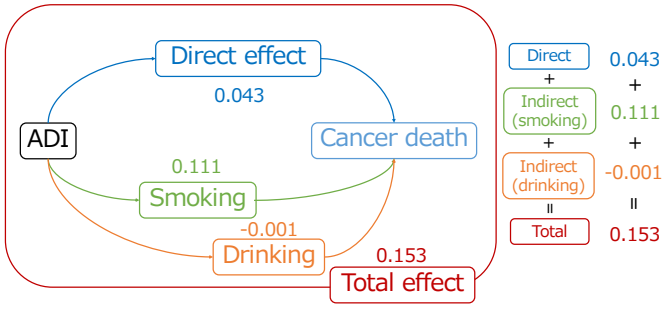
Indicator	Data source	Year
Areal Deprivation Index (ADI)	National census	2015
Standardized cancer mortality ratio	Demographic statistics	2016-18
Standardized smoking ratio	Health checkup	2016-18
Standardized drinking ratio	Health checkup	2016-18

(Note)
Standardized smoking ratio: Percentage of those who currently smoke
Standardized drinking ratio: Percentage of those who drink 46g/day or more daily
Each indicator is smoothed by full Bayesian method using map data

Mediation Analysis:

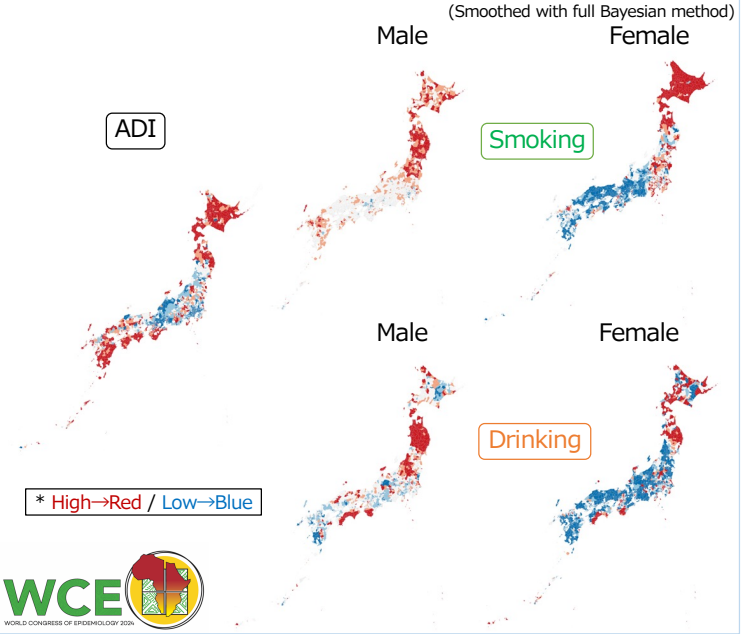
A method to analyze the impact of ADI on cancer mortality by dividing it into indirect effects via smoking and drinking and direct effects via other pathways.
(Using the full Bayesian method with the INLA package in R)

(e.g.) Lung cancer mortality (male)



Result1 ADI/smoking ratio/drinking ratio by municipality

(Smoothed with full Bayesian method)



Conclusion

Socioeconomic disparities were found to affect cancer mortality via smoking and drinking for several cancer types.
Interventions to regional smoking and drinking status may reduce cancer mortality risk in these cancer types.
On the other hand, in some cases such as **liver cancer** in men and women, in which ADI is thought to increase the risk of cancer mortality through other factors, so different interventions may be necessary.

Result2

Association analysis between ADI and smoking/drinking rates.

Relation to ADI	Slope	P value
Standardized smoking ratio male	0.21	$<2\times10^{-16}$
Standardized smoking ratio female	0.39	$<2\times10^{-16}$
Standardized drinking ratio male	0.20	$<2\times10^{-16}$
Standardized drinking ratio female	0.16	$<2\times10^{-16}$

Positive correlation found between ADI and smoking/drinking rates in both sexes.

Result 3

Impact of ADI on cancer mortality via smoking and drinking.

Male

	Direct effect	Indirect (smoking)	Indirect (drinking)	Total effect
All	0.029 (0.006 - 0.052)	0.060 (0.045 - 0.075)	-0.001 (-0.003 - 0.002)	0.088 (0.061 - 0.116)
Stomach	-0.161 (-0.217 - -0.105)	0.111 (0.076 - 0.147)	-0.002 (-0.011 - 0.007)	-0.052 (-0.119 - 0.014)
Collorectal	0.112 (0.058 - 0.166)	0.025 (-0.008 - 0.059)	-0.001 (-0.005 - 0.003)	0.136 (0.073 - 0.200)
Liver	0.110 (0.034 - 0.186)	0.137 (0.089 - 0.184)	0.002 (-0.005 - 0.008)	0.248 (0.158 - 0.338)
Pancreas	-0.103 (-0.158 - -0.047)	0.084 (0.049 - 0.120)	-0.000 (-0.002 - 0.001)	-0.019 (-0.085 - 0.048)
Lung	0.043 (0.002 - 0.084)	0.111 (0.085 - 0.138)	-0.001 (-0.004 - 0.002)	0.153 (0.104 - 0.202)
Prostate	0.077 (0.010 - 0.145)	-0.001 (-0.043 - 0.041)	-0.000 (-0.002 - 0.001)	0.076 (-0.003 - 0.156)

Female

	Direct effect	Indirect (smoking)	Indirect (drinking)	Total effect
All	-0.036 (-0.057 - -0.014)	0.085 (0.069 - 0.102)	0.009 (0.002 - 0.016)	0.059 (0.031 - 0.087)
Stomach	-0.159 (-0.218 - -0.099)	0.086 (0.044 - 0.128)	0.000 (-0.019 - 0.020)	-0.072 (-0.147 - 0.003)
Collorectal	-0.093 (-0.138 - -0.049)	0.093 (0.060 - 0.125)	0.018 (0.004 - 0.033)	0.018 (-0.039 - 0.075)
Liver	0.235 (0.154 - 0.317)	0.028 (-0.027 - 0.084)	0.008 (-0.018 - 0.034)	0.271 (0.169 - 0.373)
Pancreas	-0.172 (-0.219 - -0.126)	0.157 (0.120 - 0.195)	0.001 (-0.014 - 0.016)	-0.014 (-0.075 - 0.048)
Lung	-0.014 (-0.063 - 0.035)	0.164 (0.127 - 0.200)	0.025 (0.008 - 0.041)	0.174 (0.111 - 0.238)
Breast	-0.154 (-0.213 - -0.096)	0.098 (0.056 - 0.140)	0.033 (0.013 - 0.053)	-0.023 (-0.098 - 0.052)
Cervix	0.182 (0.071 - 0.294)	0.032 (-0.050 - 0.115)	0.015 (-0.021 - 0.051)	0.230 (0.086 - 0.373)
Uterine	-0.053 (-0.144 - 0.038)	0.063 (-0.006 - 0.133)	0.020 (-0.010 - 0.050)	0.030 (-0.088 - 0.148)

Red: significant risk increase / **Blue: significant risk reduce**

Discussion

✓ Positive indirect effects were found for both smoking and drinking for many cancer types. In particular, there was a positive total effect for male colorectal cancer and male/female lung cancer, indicating that smoking and drinking mediate the increase in cancer mortality due to socioeconomic disparities.

✓ Strong positive direct and total effects were found for male/female liver cancer and cervix cancer. This may be due to other factors, such as higher rates of infection with HBV and HCV and HPV in poor areas, rather than smoking and drinking. (Okui et al. 2022)

✓ Strong negative direct and total effects were found for female breast cancer. This may be due to the fact that poorer areas have more women giving birth, thereby reducing the risk of breast cancer. (Takeuchi et al. 2021)