

地理学的視点から多様な人間-環境関係を解明する

Understanding Diverse Human-Environment Relationships from Geographical Perspectives



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本研究分野では、様々な空間スケールにおいて変化を続ける地域社会の実態を、地理情報科学の分析技法や社会調査、フィールドワークを通して明らかにし、そこに展開する人間-環境関係のあり方や、地域的課題の発生メカニズムについて検討している。ただし、対象を自然環境に限定せず、むしろ社会的に形成されてきた建造環境、社会環境に着目し、健康、犯罪、貧困、食等の地域的課題における人間-環境関係の地理学的研究を実施している。加えて、地理情報科学における空間統計分析、空間的数理モデル、地理的視覚化、データ融合等に関する諸技法の方法論的研究を行っている。

In this research group, we study diverse conditions and the changing states of local human societies at various spatial scales; we use spatial-analysis techniques from geographic information science, social survey methods, and fieldwork to understand the development of human-environment relationships and the mechanisms that generate local challenges. However, it should be noted that this environment is not limited to the natural environment; rather, we focus on the built and social environments. We conduct studies on the associations that regional problems (e.g., health, crime, poverty, and food access) have with the many facets of such environments. In addition, we conduct methodological studies of the analytical techniques that are used in geographic information sciences, including spatial statistics, spatial mathematical modeling, geographic visualization, and data fusion.

健康地理学

本研究分野では、地理的環境と社会格差の視点から、人の健康を対象とした地理学的分析を行っている (Fig. 1)。COVID-19 パンデミックの影響についての分析は、将来の健康危機の備えの点でも継続して重要な研究課題であり、大規模な社会調査資料に基づき、日本在住外国人の COVID-19 感染およびワクチン接種と社会環境要因との関連 (Teng et al., 2025) や、都市内緑地へのアクセスを示す複数の指標と COVID-19 パンデミック期の自殺念慮との関連 (Fig. 2; Xian et al., 2025) を明らかにした。日本のパンデミック時の COVID-19 死亡を国勢調査データとのリンケージした検討では、流行拡大後において教育歴などの個人レベル要因を調整しても、大都市圏内の困窮度が高い地区で死亡率が超過する傾向が示された (Tanaka et al., 2025)。さらに、パンデミック終息宣言後においても、困窮度の高い地域では高齢者のワクチン接種率が低い傾向を確認した (Machida et al., 2025)。その他、COVID-19 以外にも多様な健康アウトカムについて健康の地理的格差に関する研究を蓄積した (Hanafusa et al., 2025; Komura et al. 2025; Matsumoto et al., 2025;)。これらの知見は、健康の社会的格差が地理的次元を伴って存在することの重要性を改めて示すものである。

Health geographies

We have undertaken a geographical analysis of human health from the perspective of the geographical environment and social inequality (Figure 1). Analyses of the impacts of the COVID-19 pandemic remain an important research agenda, particularly for preparedness for future health crises. Using large-scale social survey data, we have examined associations between COVID-19 infection and vaccination among foreign residents in Japan and social environmental factors (Teng et al., 2025) as well as relationships between multiple indicators of access to urban green spaces and suicidal ideation during the COVID-19 pandemic (Figure 2; Xian et al., 2025). An analysis of COVID-19 mortality in Japan during the pandemic, based on linkage with national census data, revealed that excess mortality persisted in socioeconomically deprived neighborhoods within large metropolitan areas even after adjustment for individual-level factors, such as educational attainment (Tanaka et al., 2025). Furthermore, vaccination coverage among older adults remained lower in deprived areas even after the official declaration of the end of the pandemic (Machida et al., 2025). We have also accumulated research on geographical inequalities in health across diverse health outcomes (Hanafusa et al., 2025; Komura et al., 2025; Matsumoto et al., 2025). Overall, these findings highlight that social inequalities in health are intrinsically shaped by geographical dimensions.

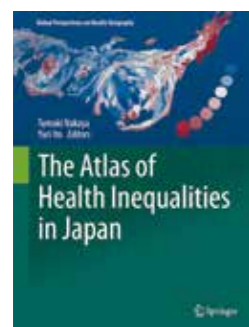


Fig. 1 Book cover of “the Atlas of Health Inequalities in Japan,” displaying a prismatic cartogram of mortality (Nakaya, T. and Ito, Y. eds., Springer, 2019)

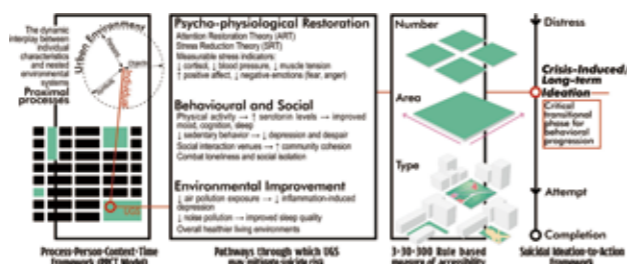


Fig. 2 Theoretical framework for urban green space and suicide risk prevention (Xian et al., 2025)

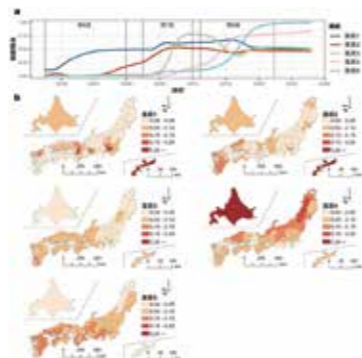


Fig. 3 Spatiotemporal Decomposition of COVID-19 Omicron Waves by Diffusion-NMF (a) temporal dynamics of coefficient scores, (b) spatial patterns of basis coefficients.

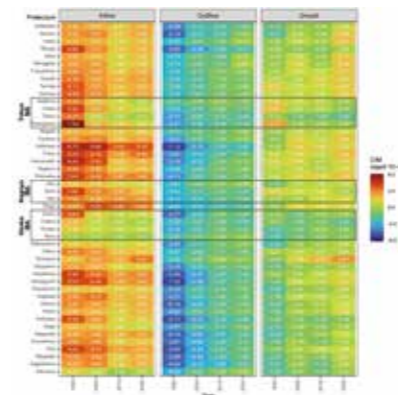


Fig. 4 Compositional Impact of Migration (CIM) on sex composition among ages 15–39 from 1990 to 2020 (Kotsubo and Nakaya, 2025)

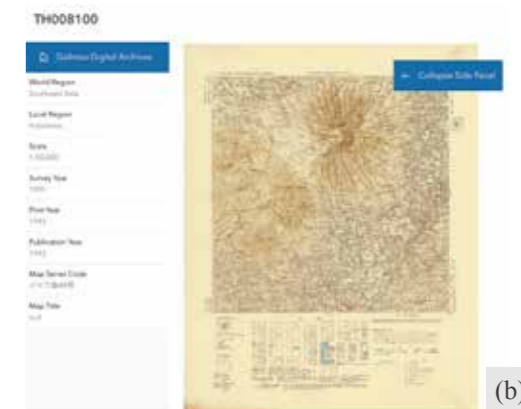
Methodology of spatial analysis and social surveys

We are engaged in methodological research, including spatial data analysis, geographic information processing, and the development of geographic social survey methods, alongside applied regional studies. Methodologically, we achieved notable results in examining spatial diffusion of the Omicron strain with interregional human travel flows and tuberculosis incidence risk using social area typologies (Yamamoto et al., 2025). In addition, with regard to survey techniques, we published an examination of a mechanical reading method applied to iPhone step-count graphs, focusing on respondent characteristics (Mori et al., 2025). In terms of the use of geographical indicators, we analyzed gender differences in internal migration in Japan using the Compositional Impact of Migration (CIM) framework, demonstrating that around 2010, Japan’s migration patterns began to resemble those observed in Western countries from the perspective of gender differences (Kotsubo and Nakaya, 2025).

We also pursue original research themes focused on the acquisition and use of historical geographic information. As a major asset of historical geographic data, Tohoku University houses approximately 10,000 Gaihozu maps—overseas topographic maps produced by the former Japanese military—and in January 2024 renewed the digital archive publication system using advanced cloud-based GIS technologies (Figure 3). Furthermore, in the current academic year, we applied machine-learning methods to extract geographical information on urban areas and low-lying wetlands from early twentieth-century topographic maps of the Korean Peninsula and examined their associations with urbanization and flood risk (Shikimi et al., 2025). In a study analyzing historical records of schistosomiasis japonica in the Obitsu River basin, we identified that past low-lying wetlands shaped by land use transitions contributed to habitats for *Oncomelania nosophora*, the intermediate host snail, and to environmental conditions associated with elevated infection risk (Nihei et al., 2025). Overall, these studies demonstrate the potential for further research linking historical land use trajectories with contemporary risks of infectious diseases and natural disasters.



(a)



(b)

Fig. 5 Gaihozu Digital Archives (<https://gaihozu-tohokugeo.hub.arcgis.com/>) (a) : Top page, (b) : An example of Gaihozu map image