Do extreme heat events aggravate the subnational inequality of Taiwan?

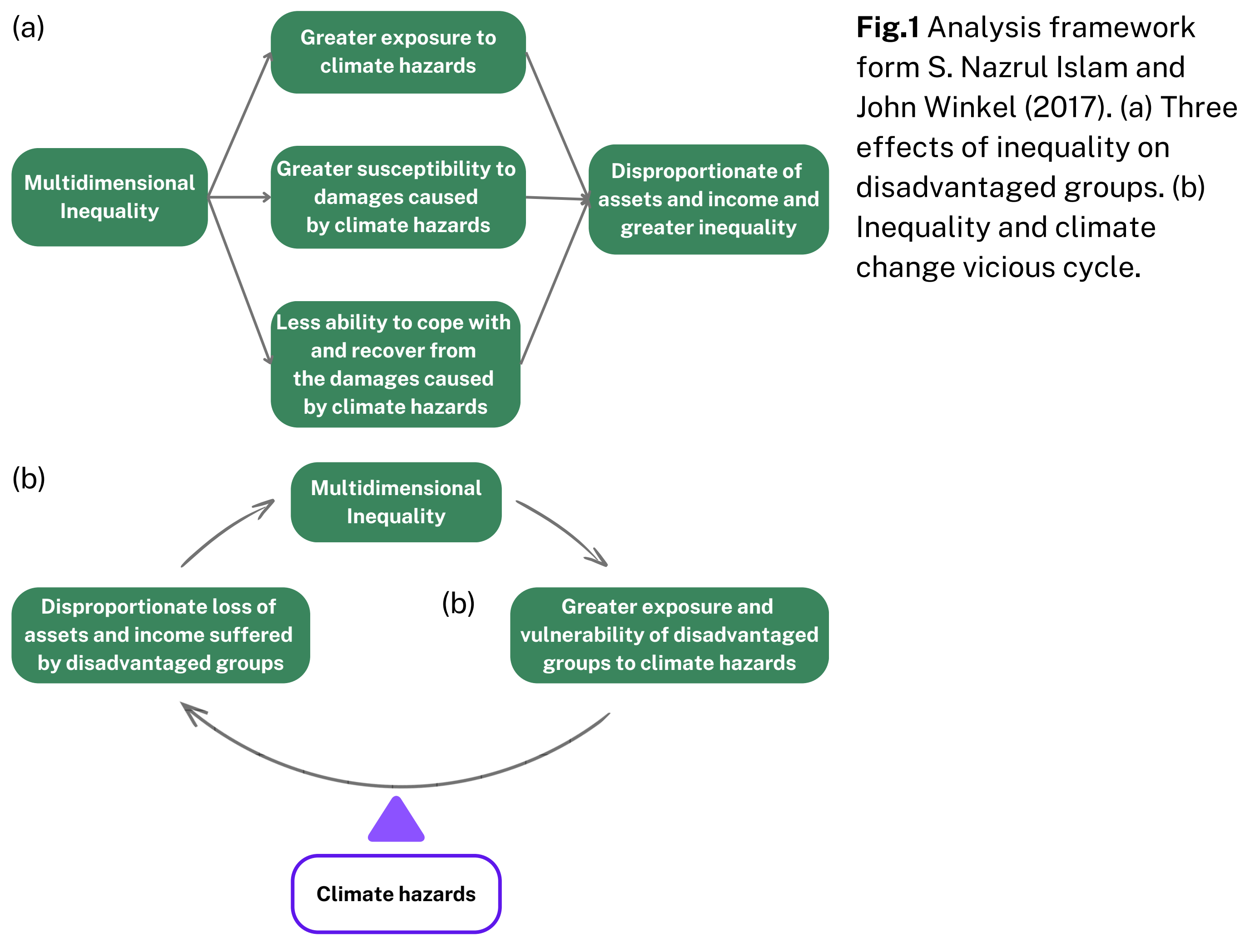Chia-Yu Lu[1], Huang-Hsiung Hsu[2], Ya-Hui Chang[2]

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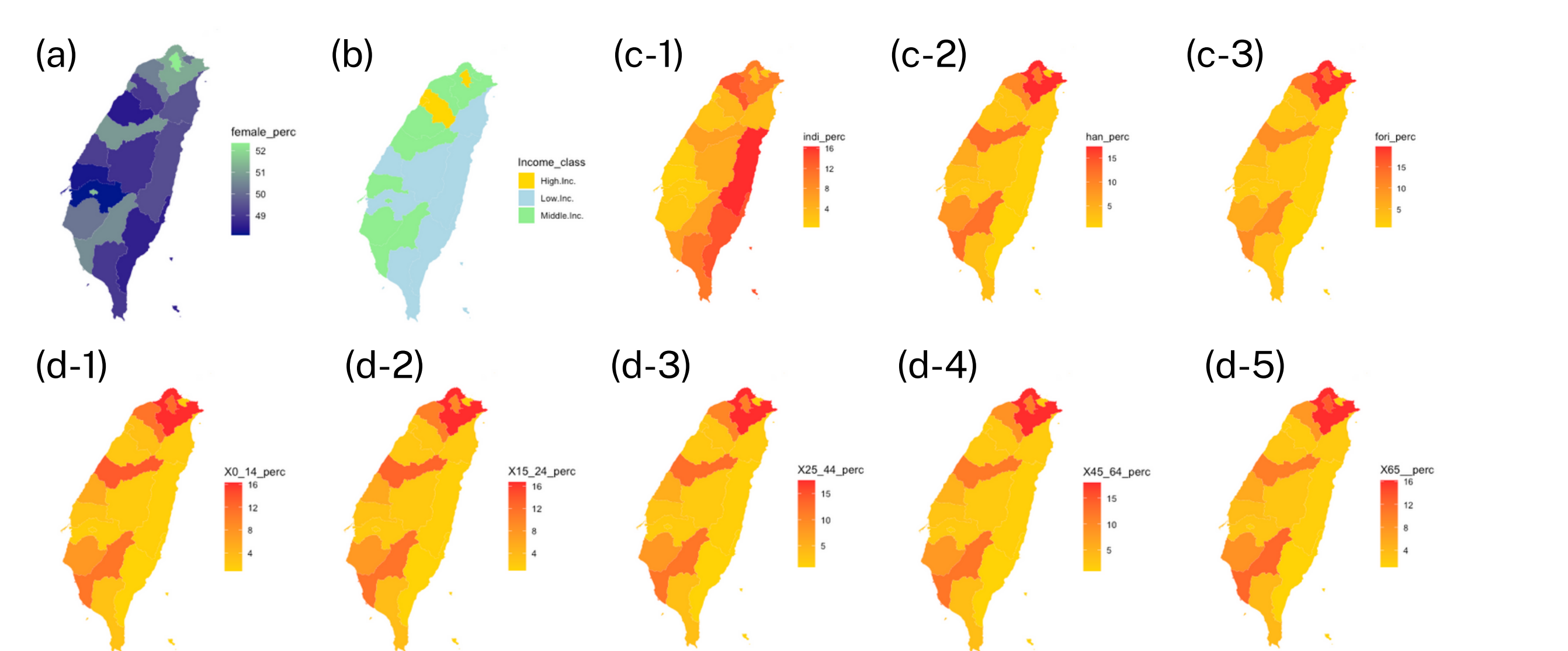
Abstract

This study analyzes the varying degrees of exposure to extreme heat across different regions and demographic groups in Taiwan, including age, gender, Indigenous populations, foreign migrants, and income levels. The research adopts the analytical framework developed by S. Nazrul Islam and John Winkel (2017) for assessing subnational socioeconomic inequalities, focusing on multidimensional inequality and the vicious cycle it creates under climate hazards. Additionally, the study incorporates the geographic analysis approach by B. Mashhoodi and D. Kasraian (2024) on heatwave exposure in the Netherlands. By integrating these methodologies, this research aims to provide a comprehensive understanding of how extreme heat impacts various communities differently, highlighting the underlying social inequalities that exacerbate vulnerability to climate change in Taiwan.

Analysis Framework

Fig.1 Analysis framework form S. Nazrul Islam and John Winkel (2017). (a) Three effects of inequality on disadvantaged groups. (b) Inequality and climate change vicious cycle.

Data

Temperature data: Averaged maximum temperature of the summer season (JJA) of 2019 from TCCIP, selected to avoid the impacts from the COVID-19 pandemic to the medical facilities.

Demographic data: Population data of several socioeconomic groups including income, sex, age, indigenous people and immigrants, divided by country/county of 2019 from the Department of Household Registration, M.O.I., ROC.

1. Heat Exposure and Urbanization

Fig.2 Heat exposure under different level of urbanization, calculated by averaged maximum temperature of the summer season (JJA) of 2019 and population density divided by country/county. (a) Low, median and high level of urbanization of Taiwan. (b) Averaged maximum temperature of Taiwan. (c) Box plot of the averaged maximum temperature categorized by low, median and high level of urbanization and the result of linear regression.

2. Distribution of Socioeconomic Groups

Fig.3 Geographical distribution of several socioeconomic groups. (a) Female, (b) income level, (c-1) indigenous people, (c-2) Han Chinese, (c-3)foreign immigrants, (d-1) age 0~14, (d-2) age 15~24, (d-3) age 25~44, (d-4) age 45~64, (d-5) age above 65.

3. Heat Exposure Inequality within Socioeconomic Groups
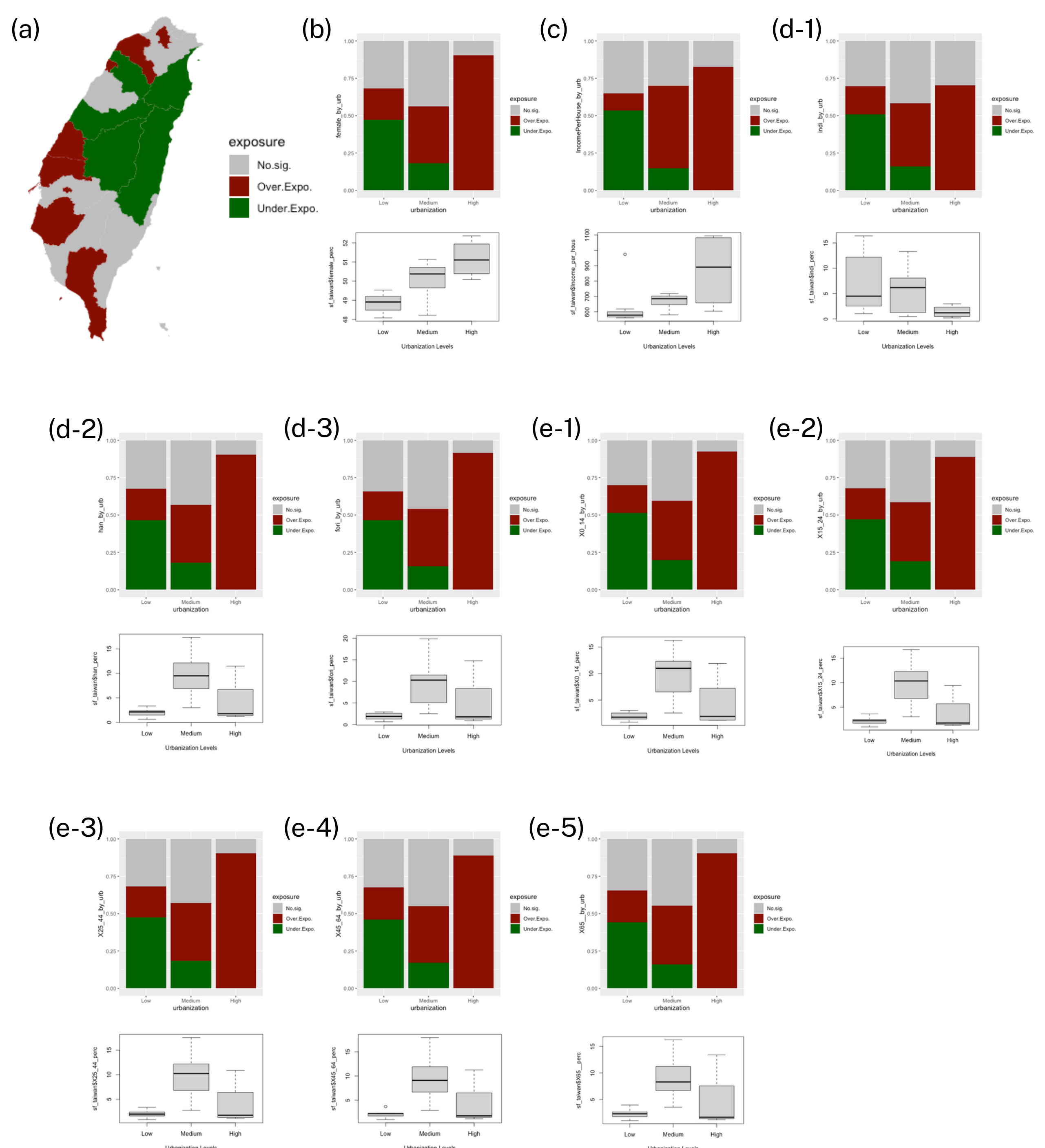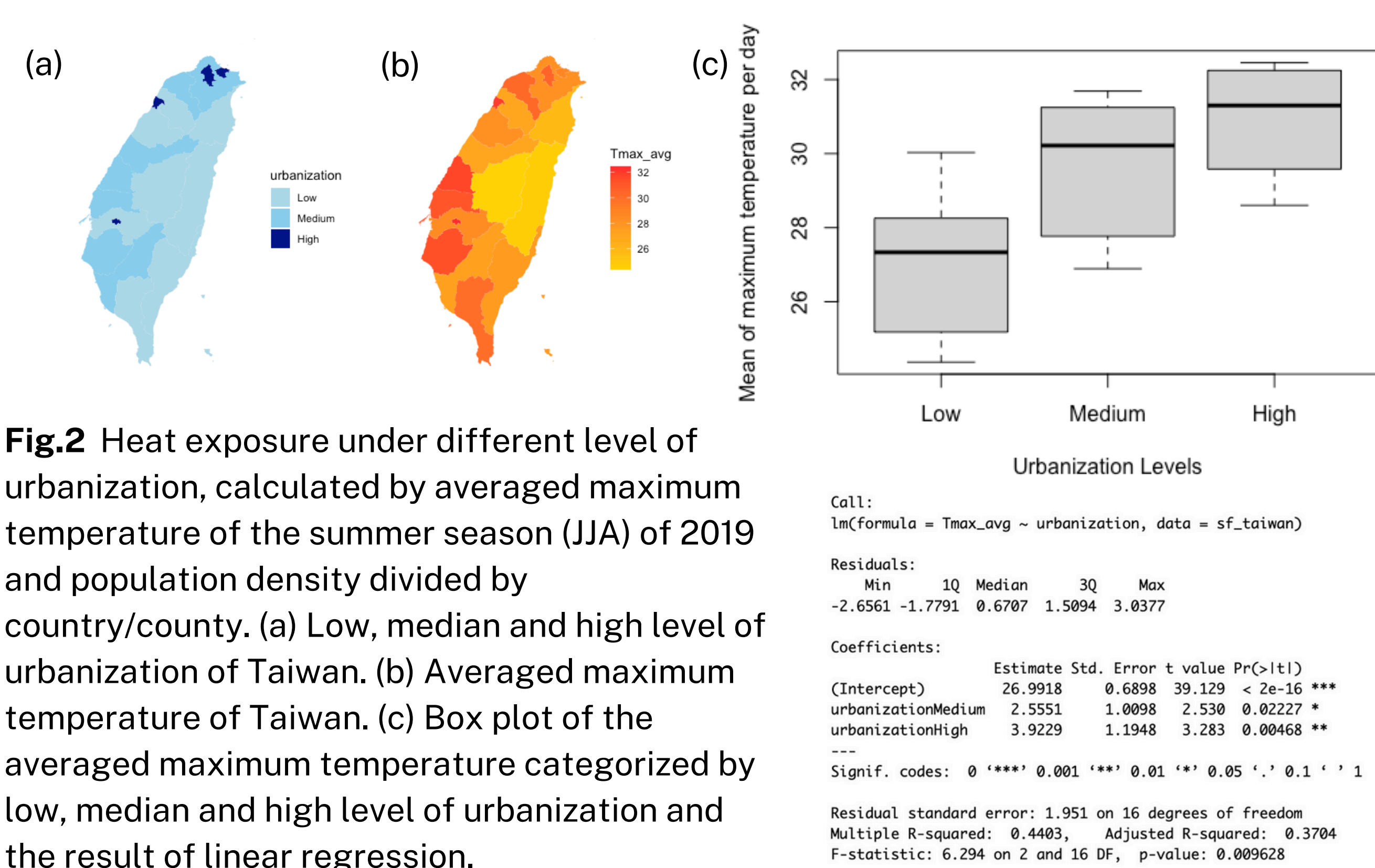

Fig.4 Distribution maps and box plots of heat exposure inequality within several socioeconomic groups. (a) Heat exposure map of Taiwan. (b) Female, (c) income level, (d-1) indigenous people, (d-2) Han Chinese, (d-3) foreign immigrants, (e-1) age 0~14, (e-2) age 15~24, (e-3) age 25~44, (e-4) age 45~64, (e-5) age above 65.

Summary

This study conducted a geographical analysis using the average maximum summer temperatures of 2019 and the degree of urbanization across Taiwan's counties and cities, categorizing them into low, medium, and high urbanization levels. The analysis revealed a significant positive correlation between the degree of urbanization and the average maximum summer temperatures, with statistical significance confirmed at the 99% confidence level. Furthermore, when examining different population groups, the findings indicated that individuals residing in areas with higher degrees of urbanization experienced greater exposure to extreme heat. This positive correlation was particularly evident among female and various income groups, as clearly illustrated by the box plots.