Health Equity: Addressing AI Bias Now or Trusting Trickle-Down Effects?

In breast cancer screening, there is a high need for the introduction of AI in both developed and emerging countries. We believe it is essential to introduce AI at an early stage to provide higher quality screening to current patients, and to verify the fairness and establish a system to ensure fairness while introducing AI afterwards.

Breast cancer is a disease for which early detection is critical, i.e., screening is important. Early detection can lead to,
- ✓ Reduction of death, mainly after distant metastasis.
- ✓ Improvement of postoperative quality of life by treating small lesions in the early stage is expected.
- ✓ The number of patients with breast cancer increases from the ages of 30s and 40s. Various life events are concentrated in this age group. It is important to start treatment at an early stage when there are more options.

1. In the case of Japan
- ✓ There is a very large difference in accuracy between cities where checkups are performed (Figs. 1 and 2). Since newer equipment models are becoming more widely used, it is difficult to imagine the influence of differences in equipment performance. It is thought that differences in performance arise in operation, i.e., in image-reading. →This indicates that the introduction of AI has the potential to reduce the negative impact of differences in reading ability.

- ✓ The accuracy of mammography is limited, and a large percentage of cancers are not detected by screening until they have advanced to a symptomatic stage (Fig. 3).The introduction of new medical equipment with higher performance other than mammography is desirable, but it will take time to develop screening guidelines. Utilizing AI prior to guideline implementation could facilitate the widespread use of new medical devices.

2. In emerging countries
   In developed countries, the number of breast cancer patients is known to increase as the number of births decreases. However, in emerging countries, the number of breast cancer patients began to increase before the medical infrastructure for treatment was in place, and the mortality rate per population has already exceeded that of developed countries (Fig. 4). However, since mammography is a difficult device to detect cancer from images, the cost of training physicians to read mammograms is a major obstacle to the spread of screening. AI is one of the important means to remove the disincentive for the spread of screening.

3. Challenges and risks in implementing AI developed in developed countries for health screening in emerging countries
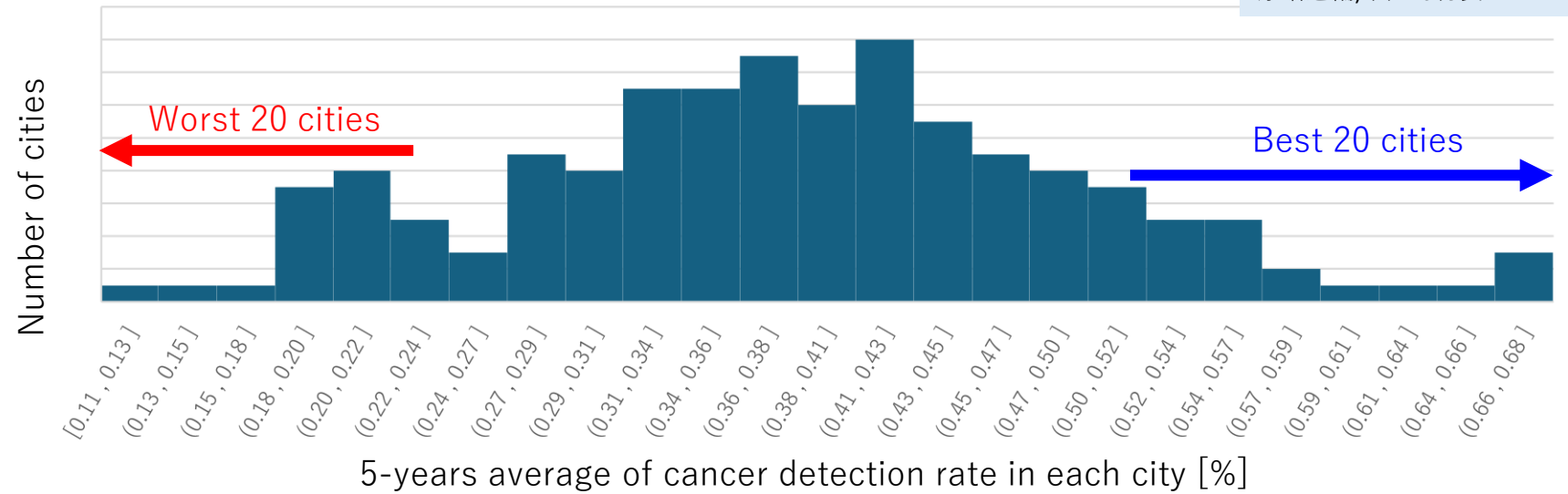   i. When developing a single global reading assistance AI, how should genetic diversity be considered in the population in which it is trained? The more diverse a population is, the more it should be included in the sample to be trained, but such research on breast cancer and genetic diversity is not well developed.
   ii. When implementing country-specific AI, the issue of biased medical device review and approval bodies in the U.S., Europe, Japan, China, etc. will have an impact.
   In conclusion, post-marketing surveillance after AI implementation is important.
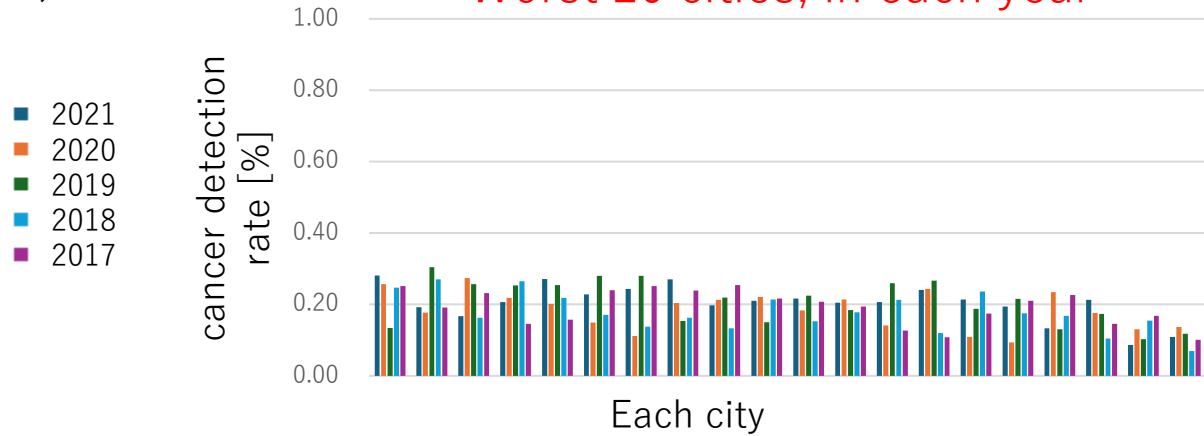
Fig. 1

a) **Number of cities for each cancer detection rate in JPN （after extracting only those cities with little variation）**

地域保健・健康増進事業報告(健康増進編)市区町村表より
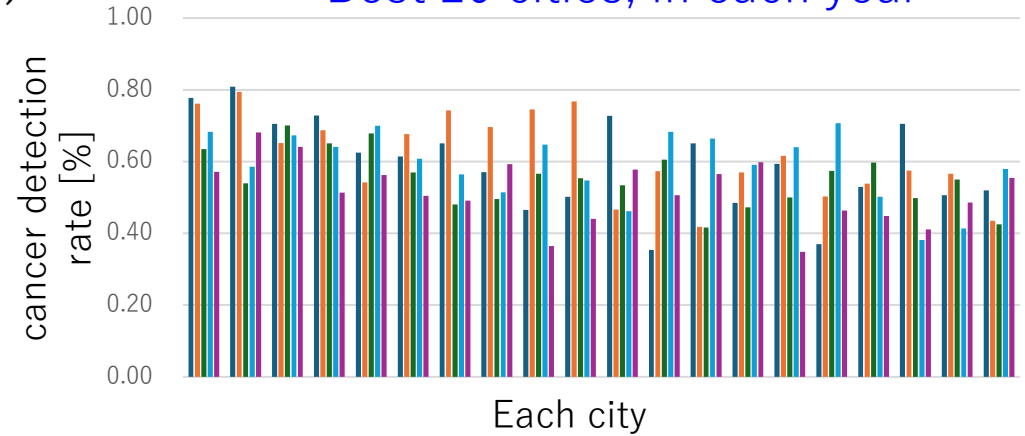
Number of cities

Worst 20 cities

Best 20 cities

5-years average of cancer detection rate in each city [%]

[0.11, 0.13] (0.13, 0.15] (0.15, 0.18] (0.18, 0.20] (0.20, 0.22] (0.22, 0.24] (0.24, 0.27] (0.27, 0.29] (0.29, 0.31] (0.31, 0.34] (0.34, 0.36] (0.36, 0.38] (0.38, 0.41] (0.41, 0.43] (0.43, 0.45] (0.45, 0.47] (0.47, 0.50] (0.50, 0.52] (0.52, 0.54] (0.54, 0.57] (0.57, 0.59] (0.59, 0.61] (0.61, 0.64] (0.64, 0.66] (0.66, 0.68]

b) **Worst 20 cities, in each year**

cancer detection rate [%]

2021
2020
2019
2018
2017

Each city

c) **Best 20 cities, in each year**

cancer detection rate [%]

Each city

Cities with high and low detection rates are not statistical variations, but are divided into stable, high-performing and low-performing cities over a 5-year period
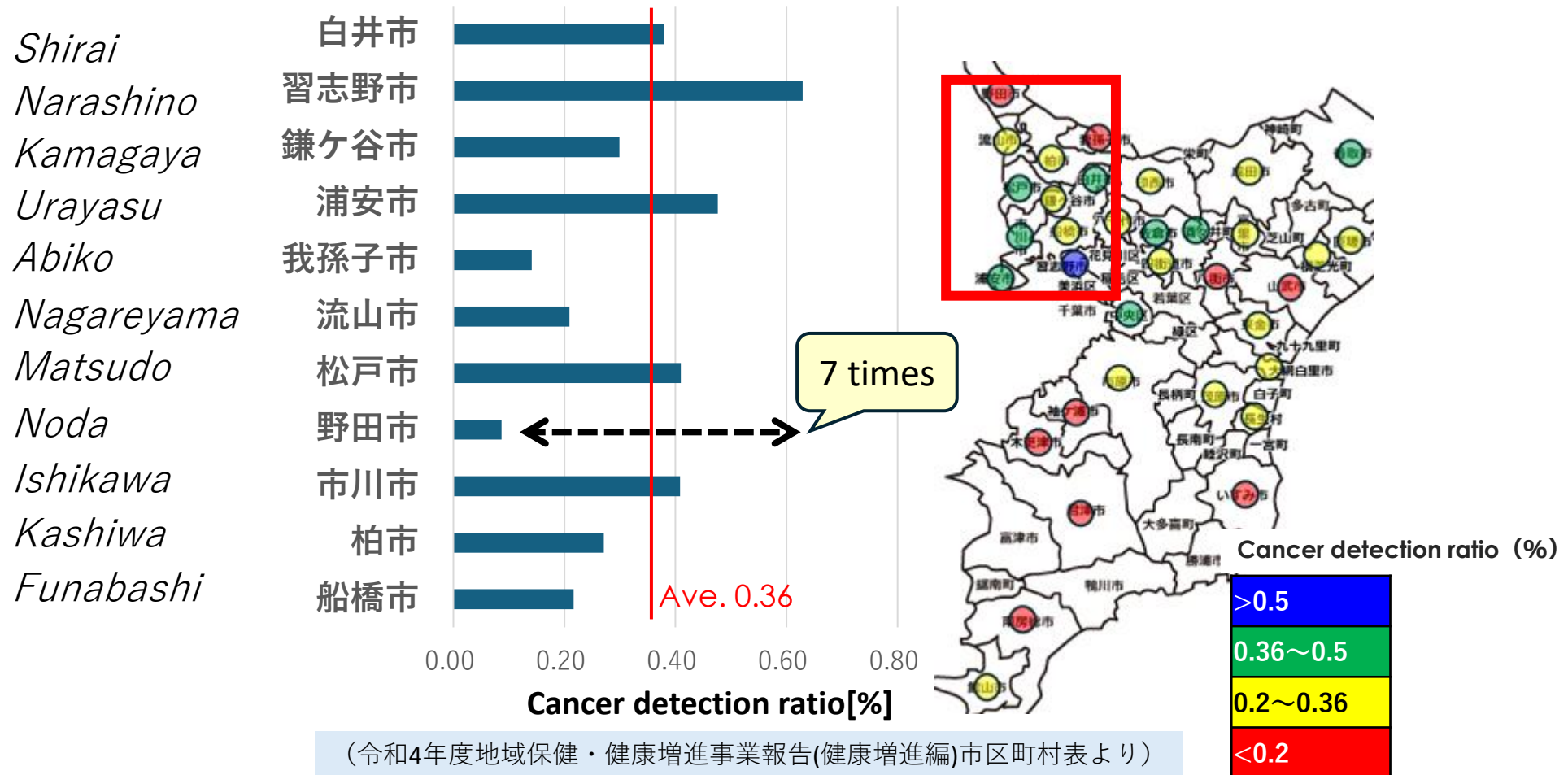
Fig. 2

Ex. Northwest Chiba prefecture

Shirai 白井市
Narashino 習志野市
Kamagaya 鎌ケ谷市
Urayasu 浦安市
Abiko 我孫子市
Nagareyama 流山市
Matsudo 松戸市
Noda 野田市
Ishikawa 市川市
Kashiwa 柏市
Funabashi 船橋市

7 times

Ave. 0.36

0.00 0.20 0.40 0.60 0.80

Cancer detection ratio[%]

（令和4年度地域保健・健康増進事業報告(健康増進編)市区町村表より）

Cancer detection ratio（%）

>0.5
0.36～0.5
0.2～0.36
<0.2

Fig. 3

**a)** Sensitivity of MRI and mammography to detect breast cancer
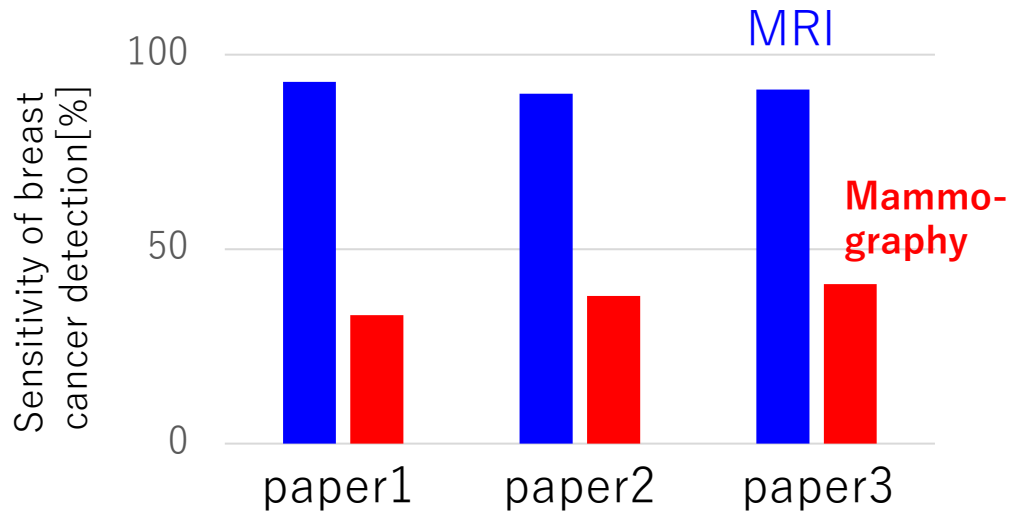
Paper1: C Kuhl et al., J. Clin Oncol, Vol. 28, 2010, p.1450-1457.
Paper2: C Riedl et al., J. Clin Oncol, Vol. 33, 2015, p.1128-1135.
Paper3: A. Chiarelli, et al, JNCI J. Natl Cancer Inst., Vol.112, No.2, 2020, p.136-144.

b)

cancer detection rate（cancer/all examinee）	0.33%
Positive Predictive Value（cancer/Findings requiring inspection）	5.62%

（令和4年度地域保健・健康増進事業報告(健康増進編)市区町村表より）

c) Number of cases of detection status relative to mass size（cm）
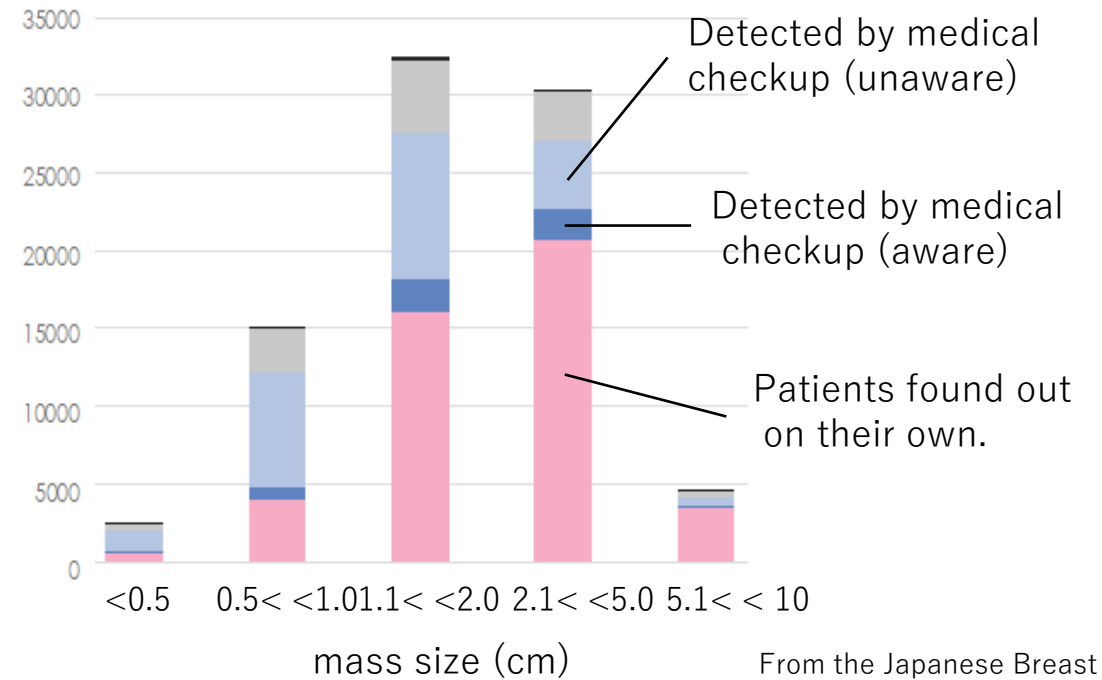
From the Japanese Breast Cancer Association Database 2020

Mammography cannot detect cancer with sufficient sensitivity because the cancer is hidden behind the mammary glands. This indicates that further performance improvement is difficult, as PPV is already in use at a very low level. As a result, many breast cancers are actually found after the stage has advanced.

Fig. 4 Incident and Mortality of breast cancer in each country