

Distance from the residence of children in
Japan to their nearest hospitals which provide
pediatric inpatient services

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Background: The number of pediatric department of Japanese hospitals decreased from 2,905 in 2008 to 2,656 in 2015, but how long sick children and their caregivers must travel to seek pediatric inpatient services is unknown.

Objectives: To measure the distance from the residence of Japanese children to their nearest hospitals providing pediatric inpatient services.

Methods (1): Calculation of Distance

- Each seat of 100,275 districts in Japan and all of 804 hospitals which notify to the health authorities to provide pediatric inpatient services was converted to the latitude and longitude using Geographic Information System.
- The distance was calculated from the difference of latitude and longitude by spherical trigonometry.

Methods (2): Formula of Calculation

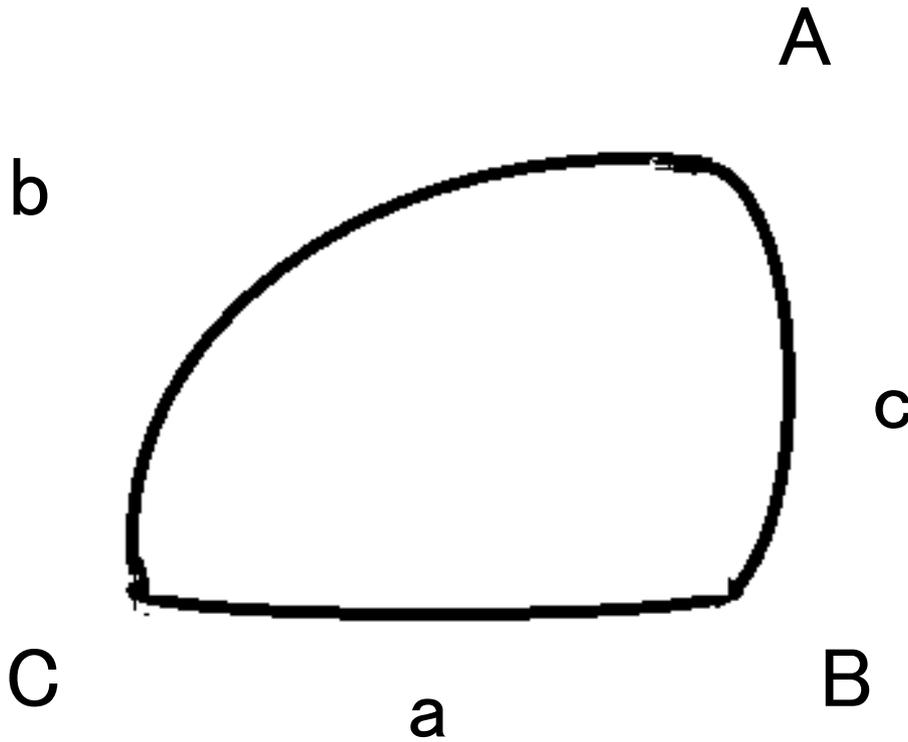
(Distance, km) =

(Radius of the Earth, 6,378km) x

$\cos^{-1} [\sin (\text{Latitude of District}) \times \sin (\text{Latitude of Hospital}) + \cos (\text{Latitude of District}) \times \cos (\text{Latitude of Hospital}) \times \cos [\text{abs} (\text{Difference of Longitude between District and Hospital})]$.

Like the Pythagorean theorem on the plane

Spherical Trigonometry



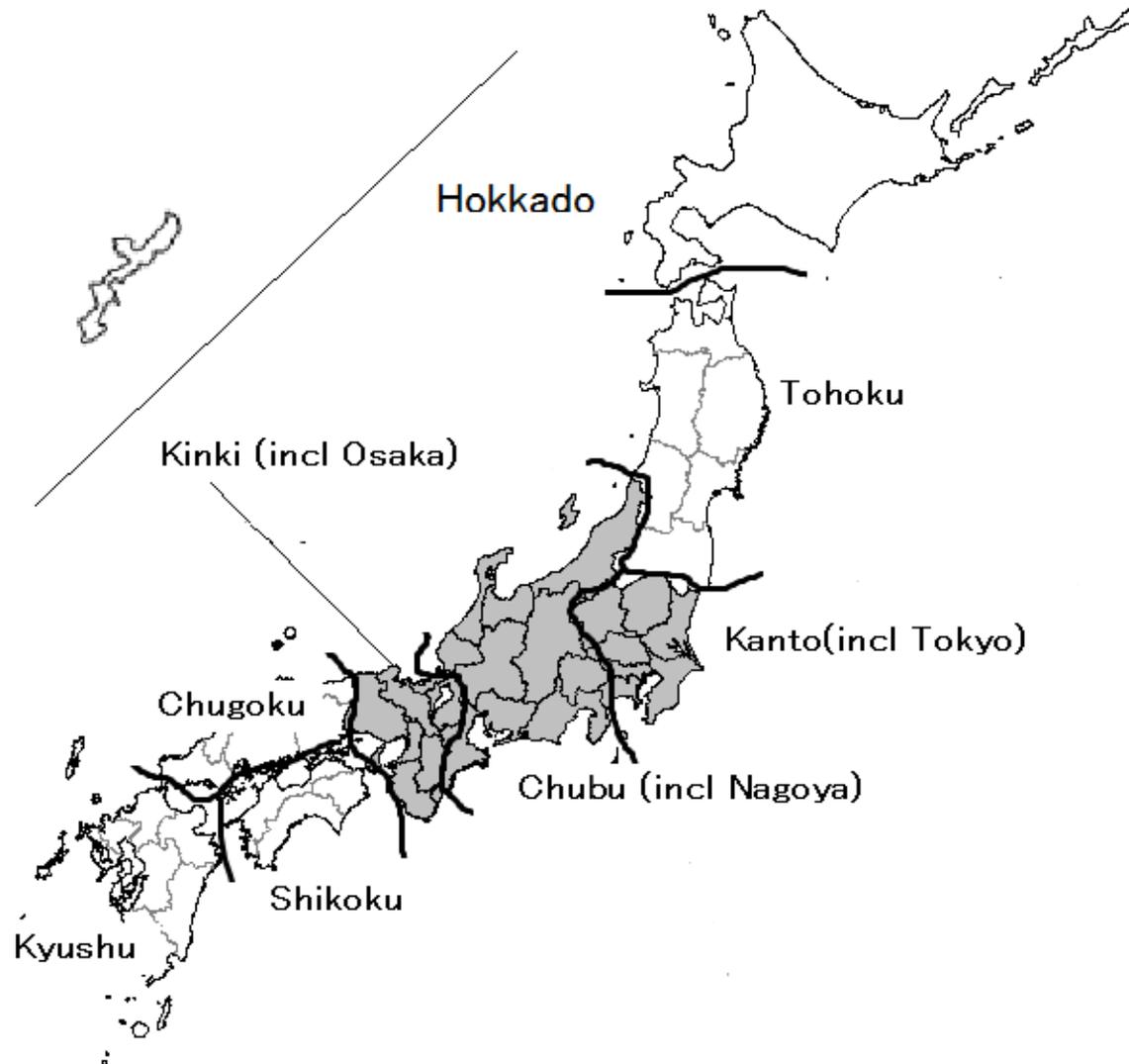
$$\cos b = \cos c \cos a + \sin c \sin a \cos B$$

Methods (3):

Proportion of the children living in the distance from the nearest hospital

- Child population : 2010 Population Census (100,275 districts)
- Proportion of child population living within the 5, 10, 20, 30 and 50 km from the hospital was calculated and compared among regions in Japan.

Methods (4) : Japanese Regions



Results

- 95% of Japanese children lived within 20km from the nearest hospitals which provide pediatric inpatient services.
- The area which cover 95% of child population in rural regions such as Hokkaido (50km), Tohoku (30km), Chugoku (30km), Shikoku (30km) and Kyushu (50km) was wider than in urban ones including Tokyo, Nagoya and Osaka (20km).
- While 95% of children lived within 50km from the nearest hospitals with at least 5 FTEs (full-time equivalents) of pediatricians, the rate was lower in rural regions such as Hokkaido (85.7%), Tohoku (77.6%), Chugoku (92.9%), Shikoku (92.4%) and Kyushu (94.8%) compared with urban ones.

Distance to the nearest hospital providing pediatric inpatient care

Region	Distance					Total
	<5km	<10km	<20km	<30km	<50km	
Hokkaido	77.3%	91.2%	93.8%	94.6%	<u>96.1%</u>	100.0%
Tohoku	48.6%	68.9%	87.6%	<u>95.0%</u>	99.8%	100.0%
Kanto	80.7%	93.4%	<u>98.1%</u>	99.8%	99.9%	100.0%
Chubu	62.5%	85.5%	<u>95.0%</u>	97.8%	99.5%	100.0%
Kinki	83.9%	94.6%	<u>99.1%</u>	99.6%	99.8%	100.0%
Chugoku	53.5%	78.7%	93.5%	<u>97.9%</u>	99.8%	100.0%
Shikoku	50.1%	71.6%	85.7%	<u>95.4%</u>	99.6%	100.0%
Kyushu	60.0%	76.4%	89.6%	93.9%	<u>98.8%</u>	100.0%
Total	70.2%	86.6%	<u>95.1%</u>	97.9%	99.5%	100.0%

Distance to the nearest hospital with at least 5 FTEs of pediatricians

Region	Distance					Total
	<5km	<10km	<20km	<30km	<50km	
Hokkaido	49.5%	64.2%	70.9%	75.5%	85.7%	<u>100.0%</u>
Tohoku	24.3%	37.7%	49.8%	59.1%	77.6%	<u>100.0%</u>
Kanto	69.1%	86.7%	<u>97.5%</u>	99.7%	99.9%	100.0%
Chubu	38.6%	63.2%	81.0%	91.4%	<u>97.1%</u>	100.0%
Kinki	63.7%	83.3%	93.6%	<u>96.1%</u>	97.5%	100.0%
Chugoku	29.0%	49.9%	70.1%	81.8%	92.9%	<u>100.0%</u>
Shikoku	30.4%	56.0%	69.9%	80.0%	92.4%	<u>100.0%</u>
Kyushu	42.8%	59.5%	76.6%	84.7%	94.8%	<u>100.0%</u>
Total	51.6%	70.8%	84.2%	90.2%	<u>95.5%</u>	100.0%

Conclusion

- Most of children in Japan lived within 20 km from hospitals which provided pediatric inpatient services, and within 50 km from big ones with at least 5 FTEs of pediatricians.
- However, in the rural regions, sick children and their caregivers must travel longer than those in urban ones to seek inpatient services.