



## A big issue on a small island—Obesity increases hypertension

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Knowledge of regional disparities in disease incidence and their factors has epidemiological significance in providing crucial information for predicting future increases and decreases in disease. In the present study [1], Fukumine et al. reported a recent trend of increasing obesity and hypertension in Yonaguni Island, a remote small island in Okinawa Prefecture, and alerted us to this issue for the future of our country. Will the relationship between lifestyle-related diseases and disease incidence on a small remote island predict disease trends in Japan in the near future, and will obesity-related hypertension really be a major future medical issue in Japan? (Fig. 1).

Obesity leads to hypertension through hemodynamic factors such as increased oxygen consumption, cardiac output, and circulating blood volume; endocrine factors such as activated renin-angiotensin-aldosterone system and enhanced sympathetic nervous system; and environmental factors such as inactivity, overeating, and increased salt intake. Increased insulin resistance and enhanced activation of adipocytokines are involved in the establishment of obesity-induced hypertension [2]. Obesity, especially visceral obesity, is the basic background of the metabolic syndrome, and increased obesity leads to increased hypertension, which in turn leads to increased metabolic syndrome-related cardiovascular disease, even in young people [3]. Recently, we reported a case of acute coronary syndrome in a markedly obese high-school girl with dyslipidemia and an unhealthy lifestyle that included overeating and habitual smoking [4]. In the review article mentioned

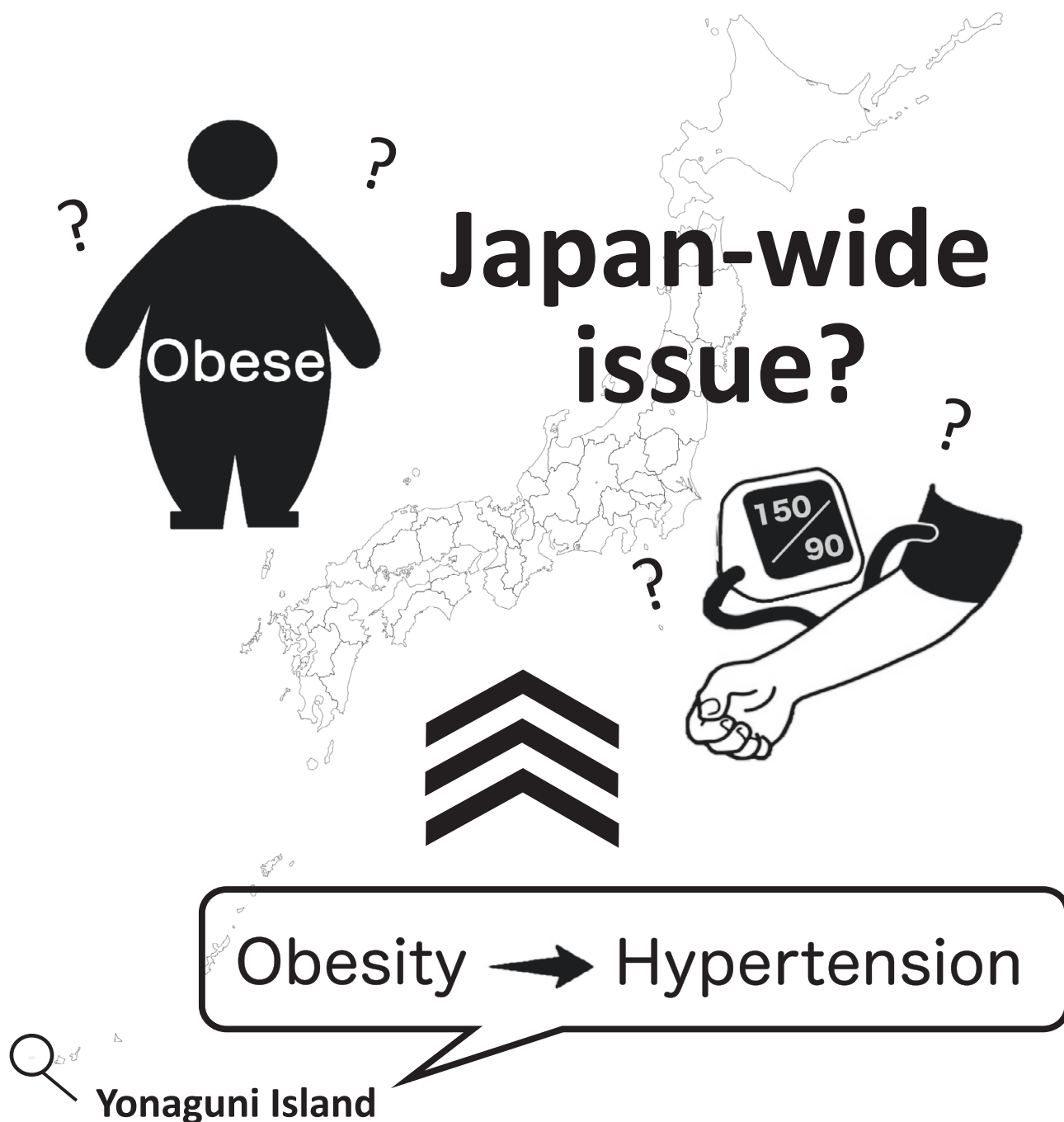
above [3], we reported that the prevalence of overweight people ( $\geq 15$  years) in Japan increased from 24.3 to 26.3%, particularly in men with an increase from 29.3 to 31.8% (Ministry of Health, Labour and Welfare of Japan website, [https://www.mhlw.go.jp/bunya/kenkou/kenkou\\_eiyouchousa.html](https://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyouchousa.html)). In the present study, 54.3% of male and 32.3% of female on Yonaguni Island were reported to be obese, which is an extremely high complication rate. Although the prevalence of metabolic syndrome was not determined in this study, in general, the prevalence of metabolic syndrome including hypertension increases with increasing obesity. Approximately 20–30% of the adult population is characterized as having metabolic syndrome, with similar trends observed in children and adolescents [3]. Obesity, however, does not always lead to metabolic syndrome, including hypertension. Two subgroups of obese youths have been proposed. One is called “metabolically healthy obese”, a group that appears to be less prone to the development of metabolic disturbances and seems to display a “favorable” metabolic state [5]. The other subgroup is called “metabolically unhealthy obese”, a group that is characterized by the alteration of one or more typical parameters of metabolic syndrome and, consequently, by a higher cardiovascular risk [6]. The present study did not analyze and could not provide information on the possibility of these “metabolically healthy obesity” and “metabolically unhealthy obesity” subtypes, which consequently indicates being less prone to develop obesity-related hypertension in the former, and prone to develop obesity-related hypertension in the later subtype.

Regional disparities or regional character in Japan have shown thus far, we must notice that obesity prevalence has been a Japan-wide issue. Despite its small land, Japan has a large regional disparity of lifestyle or disease prevalence, because of the difference of climate, food culture, economy, geography, and others. Focus on socioeconomic aspect, prevalence of hypertension is high in deprived area [7, 8]. Also, population of persons whose BMI over 25,

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**Fig. 1** Increase of hypertension due to the rise of obesity as a challenge for Japan as a whole. Signs of Yonaguni Island, a small island nation in Japan, may foreshadow the future of Japan

smoker and alcohol drinker tend to be higher in deprived area [7]. As the result to save food budget, fruits and vegetables, meat and dairy products are reduced, and cereals, sweets and fats are increased in proportion of energy component [9].

Discuss about regional disparity, food security determined by such as distance from grocery or vehicle ownership ratio, is another important aspect. In Japan, large population-ratio out of the urban area, have distance to

grocery counts more than 500 m, which suggests the existence of geographical problem to get the fresh foodstuff (<https://www.mhlw.go.jp/content/10900000/000637195.pdf>). Population which has grocery in neighborhood, show higher intake ratio of vegetables or fruits, and tend to show the lower BMI [10, 11].

In the present study, in a remote island of Okinawa prefecture, Yonaguni island where obesity is prevalent, hypertension was notably associated with obesity (BMI

>25) compared with other areas. As viewed from the perspective of socioeconomic aspect, while the central parts of Japan are less likely to be deprived, most deprived areas tended to be observed in Hokkaido and Okinawa [7]. Geographically, Yonaguni island is the westernmost point of Japan, 500 km far from main island of Okinawa. It may be possible to imagine that population in Yonaguni island are in the difficult situation to get the fresh foodstuff. From the above, socioeconomic feature as well as geographical feature are suggested to be the leading cause of high prevalence of obesity in Yonaguni island.

On the other hand, investigation among the OECD countries has shown that obesity is more common among the poor and the less educated (<https://www.oecd.org/health/49716427.pdf>). In Japan, regional disparities in terms of economy and education are not as great as in other countries, however, obesity ratio as well as childhood obesity was inversely associated in people with an advanced education, regardless of gender [12].

Even if in the circumstance not able to receive adequate education, health education, such as nutrition habits, importance of physical activity and the concrete methods of exercise, the consequences of being overweight may be effective to prevent the prevalence of obesity. While obese children who become obese adults have increased risks of type 2 diabetes, hypertension, dyslipidemia, and atherosclerosis [3], health education must be carried out from young age. Recently, use of information and communications technologies (ICT) are supposed to be effective in health education, also can be the way to keep motivation for maintaining a healthy lifestyle. In this sense, advanced medical technology utilizing ICT is indispensable for regional medical care, and regional medical care in the near future should aim for “highly advanced regional medical care” to eliminate the medical disparity with urban areas.

In an era of digital transformation in all areas, actively utilizing various types of artificial intelligence (AI) and internet of things (IoT) to manage risk factors and correct lifestyle habits to eliminate regional medical and health disparities is an important perspective in the prevention and treatment of hypertension in the near future.

## Compliance with ethical standards

**Conflict of interest** The authors declare no competing interests.

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