Changing characteristics of the type 2 diabetes epidemic of China and other Asian countries

Type 2 diabetes is a global health problem that threatens almost all nations in the world. The International Diabetes Federation (IDF) has predicted that the number of individuals with diabetes will increase from 366 million in 2011–552 million in 2030. Meanwhile, as the back-up of the huge diabetic population, some 280 million people worldwide were estimated to have impaired glucose tolerance (IGT) in 2011. By 2030, the number of people with IGT is projected to increase to 398 million.

A report from the IDF in 2006 and 2011 indicates that 80% of the worldwide disease burden of diabetes is from low- and middle-income countries. Under the globalization process of type 2 diabetes, Asia is the major site of a rapidly emerging diabetes epidemic. More than 60% of the world’s population with diabetes will come from Asia. India and China remain the two countries with the highest predicted numbers of people with diabetes (79.4 million and 42.3 million, respectively) by 2030. Additionally, four other countries in Asia – Indonesia, Pakistan, Bangladesh and the Philippines – will accompany China and India in becoming one of the top 10 countries with the highest diabetes prevalence; the updated prevalence of diabetes of these countries is 4.8% in Indonesia, 6% in Pakistan, 8.1% in Bangladesh and 5.1% in the Philippines. Furthermore, Asia remains the world’s most populous region, and the world population is expected to reach 7.9 billion by 2025; it is obvious that the number of subjects with diabetes and IGT in these Asian countries will increase substantially in the coming decades.

However, recent data from a China national diabetes prevalence survey have shown that the increasing rate of diabetes prevalence in China, in particular, exceeds the IDF estimation. The national survey was carried out with a representative sample of 46,239 adults aged 20 years or older from 14 provinces and municipalities participating in the study during 2007–2008. By utilizing oral glucose-tolerance test, fasting and 2-h glucose levels to identify undiagnosed diabetes and prediabetes, the study showed that the age-standardized prevalence of total diabetes and prediabetes were 9.7% and 15.5%, respectively, accounting for 92.4 million adults with diabetes and 148.2 million adults with prediabetes, suggesting that China has transcended India as the global epicenter of the diabetes epidemic.

It is known that Asian populations are racially heterogeneous, and have different demographic, cultural and socioeconomic characteristics. The differences in genetic and environmental factors affecting the pathogenesis of type 2 diabetes in Asian populations could also be heterogeneous. We believe that the changing characteristics of the type 2 diabetes epidemic in China will definitely have important implications for the other major Asian countries. Together with some inherent genetic factors, the growing prevalence of diabetes in China is mostly related to some changing biological and environmental factors. Analysis from the China national diabetes survey showed that age; urban or rural residence; and overweight, obesity or central obesity were the major three risk factors of diabetes or prediabetes in China (Table 1).

Older age is the common risk factor of type 2 diabetes all over the world. Although epidemic data confirmed that the peak age of type 2 diabetes onset is 70–89 years in Chinese

### Table 1 | Multivariable-adjusted odds ratios for diabetes and prediabetes

| Variable              | Total diabetes | Prediabetes |
|-----------------------|----------------|-------------|
|                       | Odds ratio (95% CI) | P-value | Odds ratio (95% CI) | P-value |
| Age, per 10-year increment | 1.68 (1.60–1.77) | <0.001 | 1.37 (1.31–1.45) | <0.001 |
| Overweight†           | 1.43 (1.22–1.67) | <0.001 | 1.42 (1.25–1.62) | <0.001 |
| Obesity‡             | 2.17 (1.68–2.81) | <0.001 | 2.05 (1.66–2.54) | <0.001 |
| Central obesity§      | 1.39 (1.18–1.63) | <0.001 | 1.22 (1.06–1.40) | 0.006 |
| Urban residence       | 1.22 (1.08–1.38) | 0.002 | 0.90 (0.81–0.99) | 0.04 |

Odds ratios were calculated with the use of multinomial logit models. All covariables listed were included in the model simultaneously. Status with respect to cigarette smoking and alcohol consumption, level of leisure-time physical activity, serum cholesterol levels, and level of economic development were not significantly associated with the risk of diabetes, and were not included in the final model. Total diabetes includes previously diagnosed and previously undiagnosed diabetes, as detected on the basis of the fasting glucose level or 2-h glucose level in an oral glucose-tolerance test. Prediabetes was defined as impaired fasting glucose or impaired glucose tolerance. †Overweight was defined as a body mass index between 25.0 and 29.9. ‡Obesity was defined as a body mass index of 30.0 or more. §Central obesity was defined as a waist circumference of 90 cm or more in men and as 80 cm or more in women. CI, confidence intervals. Adapted from Yang et al. © 2010 Massachusetts Medical Society. Reprinted with permission.
populations, it should be noted that there was an 88% increase in diabetes prevalence in the 35–44 years age group from 1994 to 2000. Similarly, recent data showed that in Indian populations, the prevalence of diabetes peak is at 60–69 years-of-age, whereas data from southern India showed that the prevalence of diabetes in people younger than 44 years has increased from 25% of the total prevalence in 2000–35.7% in 2006. The rapid increase of prevalence of young-onset diabetes in China and other Asian countries might be a result of the factors contributing to the epidemic of young-onset obesity, transition in dietary habits and nutrition intake, and significantly reduced physical activity. It should be noted that another important factor that impacts young-onset diabetes increase in Asia is inherent impaired pancreatic β-cell function, probably caused by substantial phenotypic differences between Asian and Western populations.

In recent decades, the rapid urbanization of China and many developing Asian countries, and the relatively low education level of the people living in the new urbanized areas has caused another characteristic change of the diabetes epidemic in China and Asian countries. By 2010, the proportion of urbanization will be more than 40% in China, and 30% in Pakistan, India and Thailand; the trend is more prominent in Singapore, Korea, Malaysia, the Philippines and Indonesia at approximately 50%. Urban lifestyles cause enormous changes in diet and nutrition intake, physical activity, and health status. Compared with rural residents, urban populations eat more diverse diets, more macronutrients and animal food, as well as a higher intake of refined carbohydrates, processed foods, and saturated and total fat, but lower intake of fiber. In contrast, physical activity of the residents in urban areas decreases, whereas body mass index (BMI) and upper-body adiposity substantially increases with continuous urbanization, all of which have been implicated as contributing factors in the development of type 2 diabetes. Furthermore, the age-standardized prevalence of prediabetes in China was slightly lower among urban residents than among rural residents (14.9 vs 16.0%, \( P = 0.06 \)) \(^3\). The results have important implications in that the difference of diabetes prevalence between the urban and rural areas is decreasing as a result of rapid urbanization, and the huge IGT population in the developing rural areas will provide a strong drive to a future diabetes epidemic in China and the developing Asian countries, which are undergoing quick economic growth similar to that in China. The prevalence of type 2 diabetes in these countries will probably rise further as they continue to develop economically and become increasingly urbanized.

The last important factor that contributes to the rapid growth of diabetes in China and Asian countries is the increasing prevalence of obesity, especially abdominal obesity. Excess lipolysis, causing increased concentrations of non-esterified fatty acids and triglycerides in the blood and skeletal muscle, leads to the abnormalities associated with obesity. Insulin action is impaired by changing secretion of cytokines, leptin and adiponectin, which create the so-called pro-inflammatory conditions and significantly suppress glucose uptake by muscle. In the multivariable analysis of the China national survey, overweight, obesity and central obesity were all significantly associated with an increased risk of diabetes \(^5\). The prevalence of overweight in Chinese adults increased from 14.6 to 21.8% during the decade from 1992. A similar trend has been identified in India where the prevalence of overweight ranged from 9.4% in rural Indian males to 38.8% in urban females during 2003–2005. It might explain why, together with the early onset of pancreatic β-cell dysfunction, China and other Asian populations have an even higher prevalence of type 2 diabetes than Western countries despite lower BMI. The “metabolically obese” phenotype of Asian populations characterized by normal weight or BMI, but increased abdominal adiposity, has been associated with an increased risk of both diabetes and subclinical atherosclerosis.

Type 2 diabetes and prediabetes are becoming highly prevalent in the general adult population of China, and it might imply that the same trend could occur in most developing Asian countries and areas. We believe that age, quick urbanization and rapid increase of obesity, especially abdominal obesity, are the key contributing factors of the rapid increase of the prevalence of type 2 diabetes in these countries. With consideration of a large population, rapid population growth, and rapid urbanization in China and in most Asian countries that are undergoing high-speed economic development nowadays, a huge type 2 diabetes-related disease burden could be expected as a major public health challenge in these countries in the near future. The governments of some Asian countries, including China, India, Pakistan, Bangladesh, Malaysia, Vietnam and Singapore, have initiated comprehensive national programs to prevent and control the type 2 diabetes epidemic. We would suggest that the general objective of these programs should be focused on developing an integrated strategy of population-based prevention involving early screening and diagnosis of prediabetes in the younger population, diet and lifestyle modification in the high-risk population in both urban and rural areas, and early intervention of abdominal obesity through lifestyle modification and appropriate medication intervention.

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REFERENCES
1. Available at: http://www.idf.org/diabetesatlas/5e/diabetes (accessed August 23, 2012)
2. Available at: http://www.idf.org/diabetesatlas/5e/impaired-glucose-tolerance (accessed August 23, 2012)
3. Yang W, Lu J, Weng J, et al. China National Diabetes and Metabolic Disorders Study Group. Prevalence of diabetes among men and women in China. N Engl J Med 2010; 362: 1090–1101.