Lipid control in adult Chinese patients with type 2 diabetes: a retrospective analysis of time trends and geographic regional differences

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To the Editor: Patients with type 2 diabetes have a higher risk of cardiovascular diseases (CVD), relative to people without diabetes. Patients with diabetes always exhibit lipid abnormalities. Rapid economic development and accelerated urbanization have also led to lifestyle changes that may have an influence on the lipid parameters of Chinese patients with diabetes. Given the significant differences in socioeconomic status in China, geographical variations were also observed in the prevalence, awareness, treatment, and control of dyslipidemia among individuals who were ≥45 years old in the general Chinese population.[1] There is a lack of large-scale studies regarding time trends and geographical variations in lipid concentrations and lipid control among Chinese adults with type 2 diabetes. Therefore, we conducted a study on time trends and geographical variations in lipid concentrations and lipid control in this population using the China National HbA1c Surveillance System (CNHSS) database of adult Chinese outpatients with type 2 diabetes during 2009 to 2013. The Ethics Committee of the Chinese People Liberation Army General Hospital approved the study protocol. Informed consent was obtained from all the patients before they were interviewed and data collected.

This was a retrospective study based on data from serial cross-sectional surveys during 2009 to 2013. The inclusion criteria included adult outpatients aged ≥18 years with type 2 diabetes, receiving antidiabetic medications, having resided in their location for ≥6 consecutive months, and having at least one outpatient visit for a consultation regarding type 2 diabetes with complete medical records. The exclusion criteria included treatment using only Chinese herbal medicine, pregnant or breastfeeding, and being unconscious or unable to communicate normally. Inadequate lipid control in type 2 diabetes was defined as total cholesterol (TC) concentration of ≥4.50 mmol/L, low-density lipoprotein cholesterol (LDL-C) concentration of ≥2.60 mmol/L, or triglyceride (TG) concentration of ≥1.70 mmol/L.[2,3]

To minimize the effects of extreme outliers, we excluded values for systolic blood pressure (SBP), diastolic blood pressure, fasting plasma glucose, 2-h postprandial glucose, HbA1c, TC, LDL-C, and TG that were within the highest and lowest 0.05% quantile. All statistical analyses were performed using SPSS software (version 23.0; IBM Corp., Armonk, NY, USA). Time trends in TC, LDL-C, and TG concentration were evaluated using sex-specific multivariable linear regression models adjusted by age, and a log-transformed coefficient for TG was used because of its skewed distribution. The age-standardized prevalence estimates for inadequate TC, LDL-C, and TG control were calculated for each geographic region using a direct method and the 2010 population distribution in China. Time trends in the age-standardized prevalence of inadequate TC, LDL-C, and TG control were tested using the Mantel–Haenszel χ^2 test. Regional comparisons of TC, LDL-C, and TG concentrations were performed using an analysis of variance; and regional rates of inadequate TC, LDL-C, and TG control were compared using the chi-squared test. All P values were two-tailed and P values of <0.05 were considered to be statistically significant.

Totally, 942,847 individuals (53.2% men and 46.8% women) were included in the study, with samples of 133,031 patients from the year 2009, 160,185 from 2010, 220,424 from 2011, 206,920 from 2012, and 222,287 from 2013. The mean age was 58.66 years and the median duration of type 2 diabetes was 4.05 years. The mean TC concentration was 4.71 mmol/L, the mean LDL-C concentration was 2.87 mmol/L, and the median TG

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concentration was 1.78 mmol/L [Supplementary Table 1, http://links.lww.com/CM9/A852].

The overall age-adjusted mean TC concentrations exhibited decreasing trends for both men and women during 2009 to 2013 (P for trend <0.001). There were increasing trends in the overall age-adjusted mean LDL-C concentrations and geometric mean TG concentrations for both men and women (P for trend <0.001). The time trends in overall TC, LDL-C, and TG concentrations still exhibited after further adjusting the geographical region for both men and women. Increasing time trends in the age-adjusted mean TC, LDL-C, and TG concentrations were observed in the North region for both men [Supplementary Table 2, http://links.lww.com/CM9/A852] and women [Supplementary Table 3, http://links.lww.com/CM9/A852] (P for trend <0.001).

Time trends in the overall age-standardized prevalence of inadequate TC, LDL-C, and TG control were similar to that in age-adjusted TC, LDL-C, and TG concentrations for both men and women during the study period. Decreasing trends in the overall age-standardized prevalence of inadequate TC control were observed for both men and women (P for trend <0.001), whereas increasing trends were observed in the overall age-standardized prevalence of inadequate LDL-C and TG control. Increasing time trends in the age-standardized prevalence of inadequate LDL-C and TG control were observed in the North and Northeast regions for both men [Supplementary Table 4, http://links.lww.com/CM9/A852] and women [Supplementary Table 5, http://links.lww.com/CM9/A852] (P for trend <0.001).

The clinical characteristics of the patients with type 2 diabetes varied according to the geographic region during 2009 to 2013. Patients in the North and Northeast regions had higher body mass index (BMI) values, higher rates of inadequate blood pressure control (≥130/80 mmHg), and higher rates of inadequate HbA1c control (≥7.0%) compared with the other regions [Supplementary Table 6, http://links.lww.com/CM9/A852]. Significant geographical variations were observed in the age-adjusted mean TC, LDL-C, and TG concentrations, which persisted after further adjusting for BMI. Patients in the North and Northeast regions had relatively high age-adjusted mean TC, LDL-C, and TG concentrations for both men and women [Supplementary Table 7, http://links.lww.com/CM9/A852].

The overall age-standardized prevalence was 55.87% for inadequate TC control, 56.20% for inadequate LDL-C control, and 55.32% for inadequate TG control during 2009 to 2013 [Table 1]. When standardized with geographic region, the overall prevalence of inadequate TC, LDL-C, and TG were 54.62%, 55.71%, and 53.91%, relatively. There were significant geographical variations in the age-standardized prevalence of inadequate TC, LDL-C, and TG control. Patients in the North and Northeast regions had relatively high prevalence of inadequate TC, LDL-C, and TG control, whereas patients in the South and Southwest regions had lower prevalence of inadequate TC, LDL-C, and TG control [Table 1]. After further adjusting for age, SBP, HbA1c, BMI, survey year, and duration of type 2 diabetes, North and Northeast regions still had the worst TC, LDL-C, and TG control [Supplementary Table 8, http://links.lww.com/CM9/A852].

Up to now, few studies have examined time trends in lipid profiles and lipid control in patients with type 2 diabetes from the Chinese mainland. The present study revealed decreasing trends in the TC concentrations and increasing trends in the LDL-C and TG concentrations among Chinese men and women with type 2 diabetes during 2009 to 2013. Similar time trends were also observed in the age-standardized prevalence of inadequate TC, LDL-C, and TG control.

Table 1: Age-standardized prevalence for inadequate control of TC (≥4.50 mmol/L), LDL-C (≥2.60 mmol/L), and TG (≥1.70 mmol/L) concentrations, according to the geographical region.

Items	Overall	East	North	Central	South	Southwest	Northwest	Northeast	*P* values
TC									
Total	55.87 (55.77–55.97)	55.27 (55.09–55.45)	59.16 (58.98–59.34)	50.48 (50.12–50.83)	56.09 (55.73–56.44)	48.01 (47.62–48.40)	49.63 (49.17–50.08)	59.80 (59.52–60.08)	<0.001
Men	56.89 (56.76–57.03)	55.62 (55.38–55.87)	60.38 (60.13–60.63)	51.96 (51.48–52.45)	58.07 (57.57–58.57)	49.10 (48.56–49.64)	51.22 (50.62–51.81)	61.05 (60.67–61.43)	<0.001
Women	54.21 (54.06–54.35)	54.61 (54.34–54.88)	57.41 (57.14–57.68)	48.01 (47.48–48.54)	53.21 (52.70–53.72)	46.26 (45.70–46.82)	46.28 (45.57–46.98)	57.66 (57.24–58.08)	<0.001
LDL-C									
Total	56.20 (56.10–56.30)	54.30 (54.12–54.49)	59.62 (59.43–59.80)	53.42 (53.07–53.78)	57.03 (56.67–57.38)	49.47 (49.08–49.85)	50.65 (50.19–51.1)	59.64 (59.36–59.92)	<0.001
Men	56.66 (56.53–56.80)	54.34 (54.09–54.59)	60.36 (60.11–60.62)	53.97 (53.49–54.45)	58.99 (58.50–59.49)	50.02 (49.49–50.56)	50.30 (49.71–50.89)	60.17 (59.79–60.55)	<0.001
Women	55.44 (55.29–55.58)	54.17 (53.90–54.43)	58.59 (58.33–58.86)	52.37 (51.84–52.89)	54.22 (53.70–54.73)	48.61 (48.05–49.17)	51.11 (50.40–51.81)	58.67 (58.25–59.08)	<0.001
TG									
Total	55.32 (55.21–55.42)	53.43 (53.25–53.62)	58.06 (57.87–58.24)	56.30 (55.95–56.66)	41.90 (41.55–42.26)	52.44 (52.05–52.83)	56.91 (56.46–57.36)	61.02 (60.74–61.30)	<0.001
Men	57.19 (57.05–57.33)	54.87 (54.62–55.12)	59.51 (59.26–59.76)	57.95 (57.47–58.43)	44.87 (44.37–45.37)	54.97 (54.44–55.51)	59.47 (58.89–60.06)	63.16 (62.78–63.53)	<0.001
Women	52.70 (52.55–52.85)	51.49 (51.23–51.76)	56.23 (55.96–56.50)	53.73 (53.21–54.26)	37.75 (37.25–38.25)	48.94 (48.38–49.50)	52.20 (51.50–52.91)	57.80 (57.38–58.22)	<0.001

Data are shown as age-standardized prevalence (95% confidence interval). P values were calculated using the chi-squared test. LDL-C: Low-density lipoprotein cholesterol; TC: Total cholesterol; TG: Triglyceride.

Our study showed that >50% of the patients not having adequate control of TC, LDL-C, or TG among Chinese adult patients with type 2 diabetes between 2009 and 2013, with North and Northeast regions having the worst lipid control. A previous study also based on CNHSS data indicated that the highest risks of CVD were observed in the North and Northeast regions among Chinese patients with type 2 diabetes.[4] Regional differences in lipid abnormities may be associated with lipid-lowering agents, low socioeconomic status, and unhealthy lifestyle choices, such as poor diet, limited exercise, smoking, and obesity. Moreover, our findings also indicate that poor blood pressure, HbA1c control among patients in North and Northeast regions. Therefore, measures to improve control of lipid parameters, blood pressure, and HbA1c are needed to reduce CVD-related morbidity and mortality in Chinese patients with type 2 diabetes, especially in the North and Northeast regions.

The present study had several limitations. First, time trends in lipid concentrations and prevalence of inadequate lipid control were not always stable during the 5 years; long-term studies are needed to observe more reliable time trends in lipid among Chinese type 2 diabetes. Second, our study did not collect information about awareness of dyslipidemia and lipid-lowering treatments, but a previous study indicated that the awareness and treatment rates among dyslipidemia subjects were approximately 70.0% and 55.0% among type 2 diabetes aged 45 to 75 years of age during 2010 to 2011.[5]

In conclusion, we found that Chinese adults with type 2 diabetes had increasing time trends and poor control of LDL-C and TG concentrations. There were also significant geographic regional differences in the prevalence of inadequate TC, LDL-C, and TG control, with the poorest control typically observed in the North and Northeast regions.

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Conflicts of interest

None.

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