




Aspirin use in patients with diagnosed diabetes in the United States and China: Nationally representative analysis

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Xin Wang, MD¹, Guang Hao, PhD² , Zuo Chen, PhD¹, Linfeng Zhang, PhD¹, Yuting Kang, PhD¹, Ying Yang, PhD¹, Congyi Zheng, PhD¹, Haoqi Zhou, PhD¹, Lu Chen, PhD¹, Zengwu Wang, MD, PhD¹ , and Runlin Gao, MD³

Abstract

Background: The epidemiological data on the use of aspirin in diabetic patients is very limited. The main purpose of this study is to examine the current status of aspirin use in the United States (US) and China in large representative populations.

Methods: Data came from the National Health and Nutrition Examination Survey (NHANES) and China Hypertension Survey (CHS), two nationally representative cross-sectional studies.

Results: The percentage of aspirin use was 73.8% in US diabetic patients with ASCVD, and the percentage of aspirin use in diabetic patients with high ASCVD risk was marginally higher in men ($p = .052$), 54.5% in men and 37.1% in women. The percentages of aspirin use in diabetic patients with intermediate and low ASCVD risk were 55.1% and 35.0%, respectively. In China, the percentage of aspirin use in diabetic patients with ASCVD was 53.5%, and were 14.3%, 9.7%, and 3.2% among diabetic patients with high, intermediate, and low ASCVD risk, respectively.

Conclusions: In summary, the percentage of aspirin use in primary prevention in US diabetic patients in men was higher than in women, and this percentage for primary and secondary prevention in US patients was higher than that in Chinese patients.

Keywords

Aspirin use, diabetes, China, United States

Introduction

Cardiovascular disease (CVD) and diabetes are two major causes of death, imposing a heavy burden on public health worldwide.¹ Diabetic patients had more than two to three times higher risk of CVD than people without diabetes.² Aspirin is effective in reducing cardiovascular morbidity and mortality in high-risk patients with previous myocardial infarction or stroke (secondary prevention) and is strongly recommended by the American Diabetes Association (ADA) and other guidelines.³

The epidemiological data on the use of aspirin in diabetic patients is very limited. The main purpose of the present study is to examine the current status of aspirin use in the United States (US) and China using data from the National Health and Nutrition Examination Survey

¹Division of Prevention and Community Health, National Center for Cardiovascular Disease, National Clinical Research Center of Cardiovascular Disease, State Key Laboratory of Cardiovascular Disease, Fuwai Hospital, Peking Union Medical College and Chinese Academy of Medical Sciences, Beijing, China

²Department of Epidemiology, School of Medicine, Jinan University, Guangzhou, China

³Department of Cardiology, Fuwai Hospital, Peking Union Medical College and Chinese Academy of Medical Sciences, Beijing, China

Corresponding author:

Zengwu Wang, MD, PhD, Division of Prevention and Community Health, National Center for Cardiovascular Disease, National Clinical Research center of Cardiovascular Disease, State Key Laboratory of Cardiovascular Disease, Fuwai Hospital, Peking Union Medical College and Chinese Academy of Medical Sciences, No. 15 (Lin), Fengcunxili, Mentougou District, Beijing 102308, China.
Email: wangzengwu@foxmail.com



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(NHANES) and China Hypertension Survey (CHS), two nationally representative cross-sectional studies.

Methods

Survey participants

We used the data from two nationally representative samples from the US and China, which have been designed to determine the health status of the community population. CHS study, conducted between October 2012 and December 2015, was a cross-sectional national survey to assess the status of hypertension and major CVD. The design of CHS was published previously.⁴ For the US, we accordingly selected three cycles (2011–2012, 2013–2014, and 2014–2015) from the NHANES.⁵ The research ethics boards of the National Center for Health Statistics (NCHS) and Fuwai Hospital approved these two studies, and all participants gave written informed consent at each examination.

The following selection criteria were used: 1) aged 40–75 years older; 2) data for calculating the atherosclerotic cardiovascular disease (ASCVD) scores were available on age, sex, race, smoking status, blood pressure (BP), total cholesterol (TC), and high-density lipoprotein cholesterol (H-DLC) for NHANES; and age, sex, waist, smoking status, family history of CVD, BP, total cholesterol (TC), high-density lipoprotein cholesterol (H-DLC), geographical region and living in urban/rural for CHS; 3) the participants responded to the questions on low-dose aspirin. Finally, a total of 964 US and 1642 Chinese diabetic patients were included in the analysis.

Current ASCVD was defined as self-reported coronary heart disease or stroke. Hypertension was defined as systolic BP ≥ 140 mm Hg, and/or diastolic BP ≥ 90 mm Hg, and/or use of antihypertensive medicine within 2 weeks. The 10-years predicted risk of developing ASCVD for the US was estimated by the equations recommended by ACC/AHA Prevention Guideline,⁶ and for Chinese, we used the equations developed by Yang et al.⁷ which performed better in the Chinese population. In the primary analysis, we have divided the ASCVD risk categories into $<7.5\%$, 7.5% – 15% , and $\geq 15\%$ groups, and were defined as low-risk, intermediate, and high groups accordingly.

Statistical analysis

The sample weights to account for oversampling and nonresponse were used to provide nationally representative results for CHS and NHANES. Variables were summarized using means for continuous data; frequencies, percentages, and proportions were used for categorical data. All 95% confidence intervals (CI) for the parameters were estimated (svy: proportion or mean command). Differences were examined by the two-sample t-test for continuous variables or by the Chi-square test for categorical variables. A two-

sided $p < .05$ was considered significant. Statistical analyses were conducted with Stata 14 (STATA Corp., TX, USA).

Results

For NHANES, a total of 964 diabetic patients aged 40–75 years older (50.7% men and 49.3% women) were included in the analysis. Overall, 43.6% of participants had high ASCVD risk, and male diabetic patients had a higher risk to develop ASCVD than female diabetic patients (57.1% vs. 29.8%, $p < .001$).

The percentage of aspirin use in diabetic patients with ASCVD was 73.8% (95% CI: 48.7–65.1%), and there were no sex differences; the percentage in diabetic patients with high ASCVD risk was marginally higher in men ($p = .052$), 54.5% (95% CI: 44.2–64.4%) in men and 37.1% (95% CI: 26.1–49.5%) in women. The percentages of aspirin use in diabetic patients with ASCVD intermediate and low risk were 55.1% (95% CI: 43.5–66.1%) and 35.0% (95% CI: 27.0–44.0%), respectively (Figure 1(A)). Among diabetic patients without ASCVD, 42.1% (95% CI: 37.2–47.1%) taking aspirin under the doctor's advice, and only 4.3% (95% CI: 2.5–7.3%) take them on their own. Furthermore, for the patients who take them on their own, less than half of them take them every day. However, majority of the patients taking aspirin under the doctor's advice [91.0% (95% CI: 80.8–96.1%)] take them every day. On the other hand, 61.1% and 56.7% of patients were told by a doctor or health care provider to take daily low-dose aspirin in men and women, of them, 84.7% and 74.6% of patients were taking aspirin under the doctor's advice, respectively.

In CHS, a nationally representative dataset from China, 1603 diabetic patients aged 40–75 years old (46.0% men and 54.0% women) were eligible for the analysis. Overall, 43.6% of participants had high ASCVD risk, and male diabetic patients had a higher risk to develop ASCVD than female diabetic patients (57.1% vs. 29.8%, $p < .001$).

The percentage of aspirin use in diabetic patients with ASCVD was 53.5% (95% CI: 36.2–70.0%), and there was no evidence of sex differences; the percentages in diabetic patients with high, intermediate, and low ASCVD risk were 14.3% (95% CI: 6.2–29.9%), 9.7% (95% CI: 3.5–2.4%), and 3.2% (95% CI: 1.1–8.8%), respectively. Also, we did not find sex differences for aspirin use in diabetic patients. (Figure 1(B)) However, the percentages of aspirin use in diabetic patients living in urban were significantly higher than those living in rural; the percentage in diabetic patients with ASCVD was 60.2% (95% CI: 40.5–77.0%) in urban and 31.0% (95% CI: 9.0–67.1%) in rural ($p < .001$). For the diabetic patients with high intermediate and low ASCVD risk, the percentages were 23.8% (95% CI: 9.7–47.4%), 17.1% (95% CI: 6.4–38.4%), and 6.4% (95% CI: 1.9–19.2%) for those living in urban, and only 5.4% (95% CI: 2.3–12.0%), 2.4% (95% CI: 0.9–6.5%), and 0.7% (95% CI: 0.1–3.2%) for those living in rural ($p < .001$).

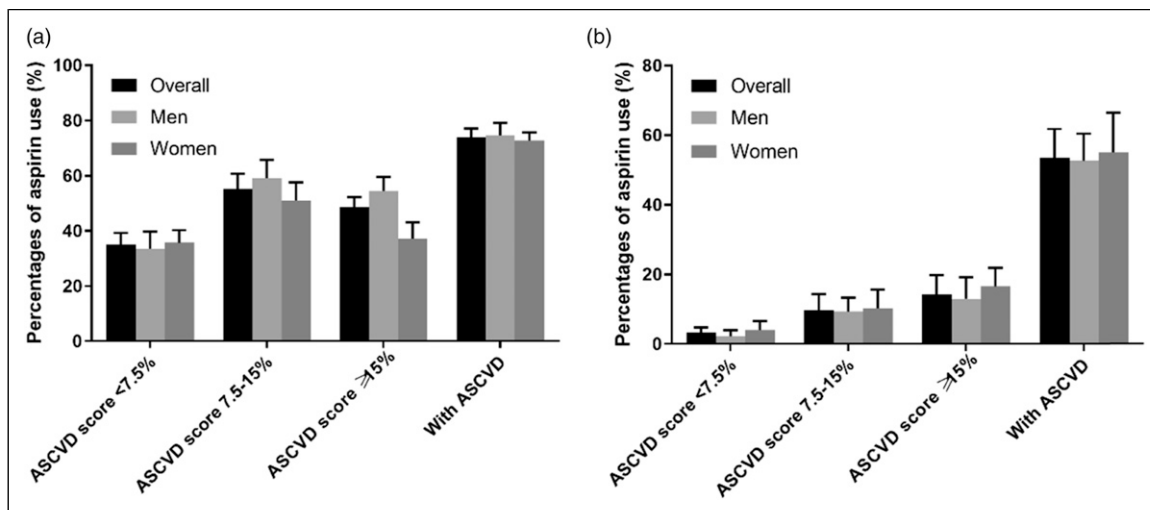


Figure 1. Percentages with standard errors of aspirin use in diabetic patients. (A) The national health and nutrition examination survey. (B) The China Hypertension Survey. ASCVD = atherosclerotic cardiovascular disease.

Discussion

Overall, the percentage of aspirin use for primary prevention in US diabetic patients with high ASCVD risk in men was higher than in women, and this percentage in US patients was higher than those in Chinese patients. Aspirin was used for secondary prevention in 73.8% of US diabetic patients, and this percentage was 53.5% in China.

Aspirin is effective in reducing cardiovascular morbidity and mortality in diabetic patients with ASCVD; therefore, using aspirin therapy as a secondary prevention strategy in those patients has been strongly recommended by ADA guideline.³ Although the protective effect of aspirin has been well established, it is still not commonly used in China, especially in rural areas. Differences in health insurance between urban and rural may explain some of the disparities in aspirin use. The New Rural Cooperative Medical Scheme for rural population only provides cover for in-hospital costs, and the requirement for long-term antiplatelet agents require out-of-pocket payment; whereas, urban residents usually hold Urban Employee/Resident Insurance that provides some coverage (70%) of outpatient medication.⁸

Emerging data have highlighted the beneficial role of aspirin in primary prevention in high ASCVD risk populations.³ Our analysis showed that 61.1% and 56.7% of US patients were told by a doctor or health care provider to take daily low-dose aspirin in men and women. In line with this analysis, previous studies showed that non-compliance with clinical practice guidelines is about 50% in the US and China.^{9,10} On the other hand, majority of the US patients (84.7% and 74.6% in men and women) were taking aspirin under the doctor's advice. Therefore, strategies for improving the adherence of doctors to the clinical practice guidelines are urgently required.

Our analysis showed that the percentage of aspirin use in China was less than a third of the percentage in the US, and the aspirin use in the rural area was even lower in China. Aspirin treatment is cost-effective not only for secondary prevention but also for primary prevention. Therefore, the appropriate use of aspirin in diabetic patients could be an avenue to decrease the heavy burden of CVD. In line with a previous study,¹¹ there was a 75% high ASCVD risk of diabetic patients (data not shown) who followed doctors' advice to take aspirin in the US. Although the CHS study did collect information on the adherence of aspirin, previous studies conducted in China reported that up to 80% of patients followed the prescription of aspirin for CVD prevention.¹² The high adherence also indicated that guideline-directed use of aspirin in doctors plays a vital role in ASCVD prevention.

Our study also has some limitations. One limitation is that CHS did not collect the data on traditional Chinese medicine for CVD prevention in Chinese diabetic patients, so the results in China should be explained cautiously. Another limitation is that certain variables in NHANES and CHS are based on self-reporting, so recall bias may exist.

Conclusion

In summary, there was a sex difference in aspirin use for primary prevention in the US. In comparison with the US, aspirin use for primary and secondary prevention was significantly lower in China. These results suggested that, according to current guidelines, informed shared decision-making between clinicians and patients regarding the use of aspirin for primary prevention of CVD could be a suitable approach. On the other hand, effective strategies to improve guideline-directed use of aspirin are urgently required.

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Author contributions

ZWW and RLG designed the study. GH analyzed data, and GH and XW wrote the manuscript. XW, LC, LFZ, ZC, YTK, YY, CYZ, HQZ, ZWW, and RLG contributed to critically revising the manuscript. All authors approved the final article.

Declaration of conflicting interests

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Availability of data and materials

The data of the HNEANS are available at <https://www.cdc.gov/nchs/nhanes/index.htm>. For CHS, the data cannot be made available to other researchers for purposes of reproducing the results or replicating the procedure. The code for analyses is available upon request from the authors.

Ethics approval and consent to participate

All participants provided written informed consent and the research ethics boards of the National Center for Health Statistics and Fuwai Hospital approved these two studies.

Appendix

Abbreviations

CVD Cardiovascular disease;
ADA American Diabetes Association

ORCID iDs

Guang Hao  <https://orcid.org/0000-0003-3780-0223>
Zengwu Wang  <https://orcid.org/0000-0003-1613-5076>

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NHANES Examination Survey
CHS China Hypertension Survey
ASCVD atherosclerotic cardiovascular disease
BP blood pressure
TC total cholesterol
H-DLC high-density lipoprotein cholesterol