



Immigration studies of cardiovascular disease and international differences in traditional Chinese medicine body constitution

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Traditional Chinese medicine (TCM) has guided health maintenance and surveillance for thousands of years in the East. The theory of body constitutions (BC) originated from the *Yellow Emperor's Canon of Medicine* and played an important role in the evolution of TCM. BC theory summarizes balanced and imbalanced health states according to individual's innate and acquired body features and classifies individuals into nine categories of BC: Gentleness type, Qi-Deficiency type, Yang-Deficiency type, Yin-Deficiency type, Phlegm-Dampness type, Dampness-Heat type, blood-stasis type, Qi-Depression type, and Special Diathesis type (1). Although TCM BC types have been standardized and extensively studied in recent years, studies conducted among populations other than Chinese are sparse except one study of white students living in China (2). Recently, the first study conducted in an American population observed that the dominant types of TCM BC among white individuals were different from the types among Chinese in China (3). Specifically, the study revealed that a large proportion of white individuals in the US exhibited Blood-Stasis type (17.3%) (3) whereas in a previous large study conducted among 8,448 Chinese participants in China, the most common pathologic BC subtypes are Qi-Deficient (13.4%), Dampness-Heat (9.1%) and Yang-Deficient (9.0%), respectively (4). This finding has been supported by two other reports by Tao *et al.* (5) and Zhu *et al.* (6) in this special issue that the difference cannot be explained by the different prevalence rates of obesity.

However, the study conducted in the American population included participants once diagnosed with colorectal polyp or at high risk of colorectal cancer (CRC) (3). Tao reported in this issue that the observed differences in the distribution of Blood-Stasis also cannot be attributable to selection bias, as well as different distributions in sex and age (5). Finally, previous evidence showed that from 23.0% to 45.6% of coronary atherosclerotic heart disease (CAHD) cases, the leading cause of mortality globally, were linked to the Blood-Stasis constitution type (7). We examined whether white Americans had higher risk of cardiovascular disease (CVD) and/or coronary heart disease (CHD) compared to Chinese immigrants in Western countries and Chinese population in China and whether the difference in risk may be linked to the different distribution in proportion of Blood-Stasis BC type.

In this study, we provided a brief mini review of migration studies of Chinese Americans on rates of CVD and CHD. Specifically, we searched for reviews or original publications on migration studies of Chinese from China to Western societies over the past decade. We compared the incidence, prevalence rate and/or mortality rates of CVD and CHD among Chinese in China, Chinese immigrants and other racial/ethnic groups in Western countries.

In a review published in 2016, Gong *et al.* reviewed the results from 16 eligible publications (8). Six of these studies reported prevalence rates of CHD in Chinese immigrants. Chinese immigrants in Western countries had

the lowest prevalence rates of CHD of 3.1–3.2% compared to 4.8–5.1% for Canadians and 4.3–5.2% for South Asian immigrants. Likewise, the prevalence rates of CHD were significantly lower among Chinese immigrants in Western countries (4.9%) compared to European men (16.6%). On the other hand, all studies found the prevalence rates of CHD among Chinese immigrants in Western countries were higher than Chinese in China. Three studies reported mortality rates of CHD in Chinese immigrants. One study was conducted in New York City and found mortality rates of CHD in Chinese immigrants were lower than white Americans but were higher compared to Chinese in China. The other two studies have generated similar results. Six studies have included prevalence rates or mortality rates of CVD, i.e., both CHD and stroke. These studies found Chinese immigrants in Western countries had higher prevalence and mortality rates of CHD than Chinese in China whereas they also had lower rates than those of other racial/ethnic groups. The results from these studies have been consistent. However, all the included studies used prevalence or mortality rates of CHD.

In a review and meta-analysis of incident rates of CHD in Chinese immigrants published in 2015 (9), Jin *et al.* conducted a meta-analysis of Chinese immigrants in Western countries. Chinese immigrants in Western countries had the lowest incidence of CHD and had odds ratio (OR) (95% confidence interval) of 0.29 (0.24–0.34) and 0.37 (0.24–0.57) compared to whites and South Asians, respectively. Collectively, these studies consistently found Chinese immigrants in Western countries had lowest prevalence rates, mortality rates and incident rates of CHD compared to whites or other racial/ethnic groups. On the other hand, Chinese immigrants in Western countries had higher prevalence rates and mortality rates of CHD than Chinese in China. These findings indicate that environmental factors, including dietary factors, in Western countries including the US, contribute to the increased risk of CHD (8).

Previous studies (3,7) have associated Blood-Stasis to CVD and CHD. In the Personalized Prevention of Colorectal Cancer Trial (PPCCT), the first study of TCM BC types conducted in the US population, proportions of Blood-Stasis were much higher in white Americans (17.3%) (3) than those from the studies conducted in Chinese population in China ranging from 1.5% to 8.1% (10,11). This was further confirmed by the report by Tao *et al.* in this issue (17.3% *vs.* ranging from 7% to 8.0%) (5). Taken together, these findings provide a possible underlying mechanism for the

increased risk of CHD in white Americans compared to Chinese in China because the proportions of Blood-Stasis were much higher in white Americans than Chinese in China.

One limitation is that all previous studies investigating the associations between Blood-Stasis and CVD and CHD were cross-sectional studies (8,9). The temporal sequence in these studies was not clear. Thus, it is possible that the associations are due to reverse causality. Thus, future prospective studies are necessary to confirm the associations between Blood-Stasis and CVD and CHD in both Chinese and US populations. Another limitation is that the first study of TCM BC types conducted in the US had a small sample size. Thus, future larger studies are necessary to replicate the findings.

In conclusion, we hypothesize that higher proportions of Blood-Stasis in white Americans compared to Chinese immigrants in Western countries and Chinese in China may provide a possible explanation for the higher risk of CHD in white Americans compared to both Chinese immigrants in Western countries and Chinese population in China. If this hypothesis is confirmed in future studies, one promising strategy for the prevention of CHD is to modify the environmental factors associated with both Blood-Stasis and CHD.

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