Title

Acculturation is associated with higher prevalence of cardiovascular disease risk factors among Chinese immigrants in Australia: Evidence from a large population-based cohort

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Abstract

Background: Evidence suggests acculturation is associated with increased prevalence of cardiovascular disease (CVD) ~~risk~~ risk factors among immigrants in Western countries. Little is known about acculturation effects on CVD risks among Chinese immigrants, one of the ~~fastest~~ fastest growing populations in Western countries. In this study, we aim to examine the association between acculturation and CVD ~~risk~~ risk factors among Chinese immigrants, Australia's~~the~~ third-largest foreign-born group ~~in Australia~~.

Methods: We accessed a~~A~~ subsample of Chinese immigrants (n=3,220) within the 45-and-Up Study (2006-2009) ~~was used~~. Poisson regression models with a robust error variance ~~was used to~~ examined the association between acculturation and CVD ~~risk~~ risk factors, and prevalence ratios (PR) ~~was~~ were reported, adjusted for socio-demographic characteristics. Indicators of acculturation included age at migration, length of Australian residence ~~in Australia,~~ and language spoken at home. The outcomes were self-reported CVD diagnosis and six ~~risk~~ risk factors (hypertension, diabetes, high cholesterol, smoking, overweight/obesity, physical inactivity).

Results: The mean age of Chinese participants was 58.9 years (SD=10.7) and 55.5% were women. Chinese migrating to Australia aged <18-~~years~~ years-old were significantly more likely to report ~~have~~ diabetes (PR=1.71; P<0.01), overweight/obesity (PR=1.49; P<0.001) and ≥-3 CVD ~~risk~~ risk factors (PR=1.47; P<0.05) compared with those who migrated after 18-~~years~~ years-old. Chinese immigrants who lived in Australia for ≥-30-years were significantly more likely to have diabetes (PR=1.84; P<0.01) and ≥-3 CVD ~~risk~~ risk factors (PR=1.84; P<0.01). There were no significant differences by language spoken at home.

The association between indicators of acculturation and CVD risk~~–~~ factors appeared to differ by sex.

Conclusion: Greater acculturation was associated with adverse CVD ~~risk~~ risk factors among Chinese immigrants in Australia.

Key words: Cardiovascular risk factors, acculturation, migrant health, Chinese immigrants

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality and morbidity worldwide(1). In particular, CVD is a major health issue among migrant populations in developed countries(2). Research suggests that acculturation is associated with increased prevalence of CVD risk factors among immigrants in Western countries(3-5). The overall prevalence and risk factors of CVD vary among subgroups of immigrants and depend on ethnic background, country of residence and the length of stay in the host country(2, 6).

However, scarce data are available on acculturation and CVD among Chinese immigrants, one of the fastest growing populations among Western countries. In the United States (US), Chinese immigrants are the second largest foreign-born group, numbering more than 2 million in 2014 (7) and the third largest foreign-born group in Australia, totalling more than 500,000 in 2016(8). Evidence indicates increasing burden of CVD risk among Chinese immigrants in Western countries. For example, a systematic review and meta-analysis found that Chinese immigrants in Western countries have higher short-term mortality after the first hospitalization for myocardial infarction compared with Whites(9). A Canadian study showed the prevalence of more than two cardiovascular risk factors increased from 2.2% among recent Chinese immigrants to 5.2% with longer duration of residence(3). In addition, lifestyle risk behaviours such as smoking and physical inactivity, which had the strongest association with mortality(10), were more prevalent among Chinese Australians than the general population(11). While a lower prevalence of CVD and associated risk factors is generally observed in China than in Western countries, acculturation to Western

lifestyles over time may lead to an increasing prevalence of CVD and risk factors among Chinese immigrants (12).

Acculturation refers to the process of change in behaviours, beliefs and attitudes that occurs when groups of people from different cultures come into constant contact with each other (13). Proxy measures of acculturation such as length of stay, age at migration and language spoken at home are commonly used in population-based studies (13, 14). As acculturation is a complex process, the use of multiple indicators may capture various aspects of acculturation, providing a deeper understanding of the contributing factors to CVD risk among immigrants during the acculturation process (15).

However, existing research on the association between acculturation and CVD risk among immigrants in Western countries mostly uses either a single indicator for acculturation (3-5), or a single risk factor (6, 16). Furthermore, studies on the association between acculturation and CVD risks mainly report aggregated data for Asian immigrants without distinguishing Chinese from other Asian groups (4, 6, 17), and this discounts the potential influence of genetic and contextual factors.

Given the rapid increase in the Chinese population in Western countries and rising burden associated with CVD, it is important to examine the association between acculturation and CVD risks among Chinese immigrants to inform policy-making and resource allocation in the context of primary prevention. In this study, we aim to examine the association between

acculturation and CVD and major CVD risk factors among Chinese immigrants in Australia using multiple measures of acculturation.

METHODS

Sampling and Procedures

The Sax Institute's 45 and Up Study is a large population-based prospective cohort study of residents aged 45-years and older living in New South Wales (NSW), the most populous state in Australia. Baseline data were collected between February 2006 and April 2009(18). Participants were randomly sampled from the enrolment database of Medicare Australia. A total of 266, 696 participants completed the baseline questionnaires (18). A more detailed description of the 45 and Up Study has been provided elsewhere (18). The study was approved by the NSW Population and Health Service Research Ethics Committee (reference no. HREC/10/CIPHS/33).

Identification of Chinese immigrants

Participants reported their ancestry and country of birth. We define "Chinese immigrants" as those who reported Chinese as their sole ancestry and who were born outside of Australia. (Figure 1).

Acculturation variables

Three variables were examined as markers for acculturation(14): age at migration, length of residence in Australia and other language spoken at home. Age at migration and length of residence were calculated from questions "What is your date of birth?", "What is the date today?" and, "What year did you first come to live in Australia for one year or more?".

Age at migration was categorized into two groups: <18-years-old ("migrated as a child/adolescent") and ≥ 18-years-old ("migrated as an adult"). Length of residence in Australia was categorized into four groups: <10 years, 10-19 years, 20-29 years, ≥30 years. Other language spoken at home was classified as "yes" and "no" from the question "Do you speak another language at home?".

Cardiovascular disease

For the purposes of this study, CVD includes coronary heart disease (CHD) and stroke. Participants were defined as having CHD if they reported 1) physician-diagnosed heart disease or 2) recent treatment for heart attack or 3) history of coronary bypass operation. Stroke was defined as self-reported, physician-diagnosed stroke.

Cardiovascular risk factors

We examined six major CVD risk factors: hypertension, diabetes, high cholesterol, current smoking, overweight/obesity and physical inactivity. Cardiovascular risk factors were operationalised both as a single risk factor and an overall CVD risk index score (e.g., having 2 risk factors, or ⩾ 3 risk factors). Hypertension, diabetes, and high cholesterol were defined as a self-reported, physician-diagnosed condition or recent treatment of that condition. Current smoking was defined by answering "yes" to "Are you a current smoker?" Overweight/obesity was defined as body mass index (BMI) > 25kg/m^2) as recommended by WHO Expert Consultation (19). BMI was calculated from self-reported height and weight, which has a good agreement (kappa=0.80) with objectively derived BMI categories in the 45 and Up Study (20). Physical inactivity was defined as not meeting the WHO

physical activity guidelines: <150 minutes of moderate-to-vigorous- intensity physical activity (bouts of at least 10-minutes) in the previous week. Physical activity levels were assessed using the Active Australia Survey(21) which has adequate validity when total minutes/week of moderate-to-vigorous physical activity is compared against an accelerometer (Spearman rho=0.52)(22).

Covariates

Covariates include the following variables: age, sex, educational attainment ("school certificate or lower"; "higher-school certificate, trade, or diploma"; "university degree or higher"), marital status ("married/living with a partner" or "other"), location of residence ("major city" versus "regional/remote") based on the Accessibility/Remoteness Index of Australia (23), and private health insurance ("having private health insurance" or "no private health insurance") as an additional marker for socioeconomic status (Jin et al 2017, Sarich et al 2015).

Statistical analysis

All statistical analyses were performed using SPSS 22 (IBM). Poisson regression models with a robust error variance were used to examine the association between acculturation and CVD outcomes, as well as risk factors among Chinese immigrants, by using less acculturated groups (age at migration ⩾18-years-old; length of residence in Australia <10-years; speaks a language other than English at home) as the reference group. Prevalence ratio (PR) was reported, adjusted for the covariates listed above. Given that acculturation

may affect CVD risk factors differently for Chinese men and women(24), sex-stratified analyses were also performed.

RESULTS

Sample characteristics

Using data from the 45 and Up Study, we investigated the association between indicators of acculturation (age at migration, length of residence and language spoken at home) and cardiovascular risk in Chinese immigrants (n=3,220). The mean age of the Chinese participants was 58.9-years (SD=10.7) and more than half were women (Table 1). The majority of Chinese participants lived in a major city and most had private health insurance. Nearly 95% of Chinese immigrated to Australia in adulthood. Most Chinese immigrants lived in Australia for more than 10-years and the majority spoke a language other than English at home (Table 1).

Self-reported CVD diagnosis

None of the acculturation indicators was significantly associated with self-reported CVD diagnoses among Chinese immigrants (Supplementary 1).

Cardiovascular risk factors

Age at migration

Chinese immigrants arriving in Australia as a child/adolescent had worse cardiovascular risk profiles than those migrating at an older age (Table 2). Chinese immigrants arriving in Australia as a child/adolescent were significantly more likely to be overweight/obese (PR 1.49; P<0.001), have diabetes (PR 1.71; P<0.01) and to have more than 3 risk factors (PR

1.47; P<0.05) compared with those who immigrated as an adult (Table 2). Sex-stratified analysis showed both similarities and differences (Table 2): migrating at a younger age was associated with higher prevalence of overweight/obesity in both men and women, but with a higher prevalence of diabetes only in women (Table 2). Migrating as a child/adolescent was also significantly associated with a higher risk of overweight/obesity among Chinese men but not women (Table 2).

Length of residence in Australia

Longer duration of residence in Australia was associated with some cardiovascular risk factors (Table 3). Compared with participants of less than 10-years of residence, Chinese immigrants who lived in Australia for longer than 30-years were significantly more likely to have diabetes (PR 1.84; P<0.01) and more than 3 risk factors (PR 1.84; P<0.01) (Table 3). In sex-stratified analysis, the pattern associated with length of stay and cardiovascular risk factors varied between men and women (Table 3). For example, compared with Chinese men who lived in Australia for less than 10-years, those who lived in Australia for more than 30-years were significantly more likely to be physically inactive (PR 1.40; P<0.05) and have more than 3 risk factors (PR 1.86; P<0.05). Compared with Chinese women who lived in Australia for less than 10-years, those who resided in Australia for more than 30-years were more likely to have hypertension (PR 1.47; P<0.05) and less likely to be physically inactive (PR 0.73; P<0.05) (Table 3).

Language spoken at home

There were no statistically significant differences between Chinese immigrants who spoke English and those who spoke a language other than English at home (Supplementary 2) in either the combined or sex-stratified analysis.

DISCUSSION

Our study is the first to examine the associations of acculturation with CVD risk factors and outcomes among Chinese immigrants in Australia. Our results found that a higher level of acculturation, measured by age at migration and duration of residence, was associated with worse cardiovascular risk profiles, particularly overweight/obesity, diabetes and higher risk index scores among Chinese immigrants. In particular, those who migrated as a child/adolescent were more susceptible to cardiovascular risk factors. Moreover, there are sex differences in the association between acculturation and CVD risk factors. However, we did not observe an association between language spoken at home and CVD risks.

Our findings were consistent with previous studies among Asian immigrants in North America which found a positive association between acculturation and prevalence of cardiovascular risk factors (3, 4, 6). The increasing prevalence of overweight/obesity and diabetes may reflect acculturation to Western lifestyles and subsequent behaviour changes, such as the adoption of an unhealthy diet (6, 25). Chinese immigrants are found to have dietary changes after immigration characterised by increasing consumption of processed food, saturated fats, sugars and soft drinks (26, 27). Moreover, lifestyle risk factors for diabetes, such as physical inactivity and smoking (28, 29), are highly prevalent among

Chinese immigrants (11). These lifestyle risk factors are particularly detrimental to people of Chinese ancestry because Asians have been found to have higher genetic predisposition to type-2 diabetes (30). Specifically, studies have found that Asians have a higher proportion of body fat and a worse profile of abdominal obesity compared with those of European descent with similar BMI, which predisposes Asians to insulin resistance at a lesser degree of obesity (31, 32). As a result of both genetic predisposition and lifestyle risk factors, this increasing trend of overweight/obesity and diabetes among Chinese immigrants is alarming and it has paralleled nutrition transition and lifestyle changes resulting from rapid economic growth and urbanization in China (30, 33).

In our study, we observed that Chinese who immigrated as a child/adolescent were more likely than adult migrants to be overweight/obese for both sexes, which is consistent with previous findings among immigrants (15, 17, 34). This could be because childhood and early adolescent exposure to Western culture is associated with a quicker adoption of a Western lifestyle, which predisposes the immigrants to obesity (26, 34). These changes can affect BMI and body composition during childhood and later in life, having a lasting impact on future cardiovascular health, including diabetes, obesity and CVD (34, 35).

Increasing length of residence was not significantly associated with overweight/obesity in our study. Although previous cross-sectional studies suggest that longer duration of residence in Western countries is associated with a higher BMI among immigrants generally (4, 6, 36), results among Asians were mixed (6, 27, 36) depending on the different ethnic origin of Asian subgroups. The inconsistent findings using different indicators of acculturation in our study could reflect younger Chinese immigrants adopting the

unhealthy behaviours of the host culture more quickly, with adult immigrants perhaps more likely to retain their culture practice of origin regardless of the length of residence in Australia.

Our results showed significant differences in the association between acculturation and cardiovascular risk factor profiles by sex, except for overweight/obesity, which is consistent with a previous study (van Oeffelen 2015). Specifically, prevalence of physical inactivity differed significantly by length of residence in opposite directions: the prevalence of physical inactivity was significant higher for male Chinese who lived in Australia more than 30-years, while it was significantly lower for female Chinese, however, this pattern was not observed by age at migration. Although the reasons for these sex differences are unclear, and may require a more in-depth qualitative inquiry, it has been proposed that women may adapt to the cultural norms of the host country more quickly than men, such as smoking (37). Given that leisure-time physical activity (the primary domain captured by the Active Australia Survey (21), is not regarded as a cultural norm in traditional Chinese society, Chinese immigrant women may be more influenced by the norms of health behaviours in their host country, such as regular leisure-time physical activity (38).

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Although acculturation was associated with increased diabetes among Chinese immigrants in general, higher prevalence of diabetes was significantly associated with younger age at migration among females, but not significantly associated with increased length of residence. A previous study also showed longer duration in Canada was not significantly associated with increased prevalence of diabetes among female Chinese residents (Chiu et

al 2012). While the inconsistent findings arising from these two different indicators were unclear, and could be clarified by future research in this area, it has been suggested that overweight/obesity is the main contributor to diabetes among Chinese people in China (Wang et al 2015). Given there is a higher prevalence of overweight/obesity among those who migrated as a child/adolescent, this could explain why a higher prevalence of diabetes was associated with younger age at migration.

Our findings demonstrated that there were no significant differences between Chinese immigrants who spoke English and another language at home. It is possible that the language spoken at home did not reflect the actual level of English competency because English proficiency (often considered an indicator of acculturation(14)) was not measured in our study. However, this finding echoed previous studies using English proficiency as a proxy measurement, which indicates that language may not be a sensitive measure of acculturation among Asians immigrants(39, 40). It could be because Chinese immigrants are a heterogeneous group in terms of their origins and linguistic backgrounds (41, 42). There is considerable within-group diversity of English proficiency among Chinese immigrants. Recent immigrants are mainly from mainland China, but historical immigrants came from Hong Kong, Taiwan, Macao, Singapore and Indonesia and were often fluent both in English and their native language (41, 42). These bilingual Chinese immigrants may speak their first language with their relatives at home but English with workmates or friends outside their ethnic neighbourhood.

STRENGTHS AND LIMITATIONS

Our study draws on a large population-based cohort with sizeable numbers of Chinese immigrants. Being the first Australian study on acculturation and CVD risk in Chinese immigrants, our study examined a broad range of CVD risk factors, both singularly and jointly (10). To our knowledge, our study is the first to use three indicators for acculturation on migrant research in Australia, which provides a comprehensive understanding of acculturation and CVD. By using diverse indicators of acculturation, our findings reveal the relationship between different indicators of acculturation and CVD risk factors is complex and context-specific. Future studies may consider a composite indicator of multiple measures including social and cultural norms to validate measures of acculturation.

Findings from our study should be interpreted in the light of its limitations. First, the association between acculturation and CVD risk is based on cross-sectional analysis without causal inferences and should be interpreted with caution. Second, the current measures of CVD outcomes and risk factors were based on self-reported physician diagnosis. Despite established validity of several measures of CVD-related outcomes such as diabetes(43), these outcomes could be differentially underestimated among the participants who are less acculturated, due to the possibility of a higher prevalence of undiagnosed diseases. Future data linkage could provide more objective CVD outcome findings. Third, the 45 and Up Study questionnaire was only available in English. Therefore, Chinese participants with lower English proficiency were less likely to be enrolled in this study. Fourth, regarding language, the 45 and Up Study only asked “Do you speak another language other than English at home?”. It did not ask specifically about

the type of language spoken at home or language proficiency. Finally, there could be synergistic effects arising from the use of three proxy measures of acculturation. Future acculturation research could benefit from more specific and robust acculturation measures.

CONCLUSION

Our study showed that higher levels of acculturation were positively associated with CVD risk factors among Chinese immigrants in Australia. With the rapid increase in Chinese immigrants to Western countries, an understanding of risk factors in relation to acculturation could help predict the future burden of cardiovascular disease among this group. The findings from this study highlight the importance of both clinicians and policymakers proactively developing and implementing interventions to prevent future increase of CVD among Chinese immigrants. Future longitudinal studies with sensitive and specific acculturation measures should improve the current level of evidence to better inform the development of culturally-specific interventions to lower the burden of CVD risk factors among Chinese immigrants.

Author contribution

KJ and DD contributed to the conception and design. KJ, JG, LN, FK and DD contributed to the acquisition, analysis or interpretation of data for the work. KJ drafted the manuscript. All critically revised the manuscript and gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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Conflict of Interest Disclosures

The Authors declare that there is no conflict of interest.

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