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Longitudinal study of acculturation and BMI change among Asian American men

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ABSTRACT

Background. Cross-sectional studies examining the association between Western acculturation and BMI in Asians have been inconsistent, and studies on BMI change are lacking.

Objective. This study examined the associations between indicators of acculturation (generational status, length of US residence, and age at immigration) and overweight (BMI ≥25 kg/m^2) as well as 5-year BMI changes in 7,073 Chinese, Japanese, Korean, Filipino, and Vietnamese men who lived in the US and were 44–71 years old at baseline of the California Men's Health Study (2002–2003).

Methods. Indicators of acculturation were reported at baseline. Repeated clinical measures of BMI were extracted from electronic health records (2005–2012).

Results. Using generalized estimating equations we found that lower generational status, shorter duration of US residence and older age at immigration were inversely associated with being overweight. However, analysis of BMI curves using linear mixed models showed that shorter length of US residence and older age at immigration were associated with larger 5-year increases in BMI.

Conclusions. Asian immigrants who were less acculturated had larger BMI increases as they became more acculturated but had not achieved overweight status. Healthy weight interventions among Asians immigrants may be most effective when targeting weight maintenance early in the process of acculturation.

Introduction

Asians living in the US (Asian Americans) have a higher prevalence of overweight and obesity compared to Asians living in their ancestral countries (Schiller et al., 2012; Stevens et al., 2012). These differences may be explained by exposure to a Western environment and acculturation, the process of adopting cultural traits of the host country (Berry, 1997). However, cross-sectional studies examining the association between acculturation and body mass index (BMI) in Asian immigrants to Western countries have been inconsistent. Some studies found no association (Park et al., 2008; Kaushal, 2009; Huang et al., 1996), while others found a positive association (Gomez et al., 2004; Klatsky and Armstrong, 1991; Oza-Frank and Narayan, 2010; Cairney and Ostbye, 1999; Bates et al., 2008). The authors of most studies combined all Asians and do not account for potential heterogeneity between Asian subgroups (Salant and Lauderdale, 2003). Similarly, among Latinos, it has been shown that combining subgroups can cause methodological problems (Umaña-Taylor and Fine, 2001). Additionally, BMI examined in cross-sectional studies might have been the same since pre-migration. Longitudinal studies on BMI change could clarify the previous contradictory results by assuring that the observed changes in BMI associated with different levels of acculturation occurred after immigration.

The obesity epidemic in the US has been linked to consumption of energy-dense foods and physical inactivity, characteristics of an obesogenic environment (Hill and Peters, 1998). Acculturation to these norms may have detrimental effects on the health of Asian immigrants (Horgen and Brownell, 2002). A pioneering study of the health consequences of American acculturation in Asians is the Honolulu Heart Program, which approximately 50 years ago recruited 8,006 men of Japanese ancestry living in Hawaii (Huang et al., 1996; Reed et al, 1982). A higher level of maintenance of Japanese culture, measured using three self-reported scales (culture of upbringing, current

Abbreviations: BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease; IRB, Institutional Review Boards; OR, odds ratio

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cultural assimilation, and current social assimilation), was related to lower levels of BMI in a cross-sectional analysis (26 vs. 23 kg/m^2 in lowest vs. highest quartile, $P < 0.05$). Contrary to expectation, Japanese born in Hawaii did not have a significantly different mean BMI compared to those born in Japan. This may be because data were collected prior to the US obesity epidemic, which was first detected in the late 70s (Flegal et al., 1998). More recently, there have been huge transitions in the economy, lifestyles, and obesity prevalence in many Asian countries (Popkin, 1994). Therefore, early research has limited application to recent waves of Asian immigrants to the US.

Our study determined associations of measures of acculturation (generation, length of US residence, and age at immigration), indicating an immigrant's exposure to the Western environment, with overweight (≥25 kg/m^2) and longitudinal changes in BMI among Asian men. We also sought to examine potential heterogeneity within the Asian population by analyzing results for Asian subgroups separately (Chinese, Japanese, Koreans, Filipino, and Vietnamese). To our knowledge, this is the first study that has used serial assessments of measured BMI to examine the impact of Western acculturation in Asians.

Methods

Study population

The California Men's Health Study is a prospective cohort initiated by Kaiser Permanente Northern and Southern California in 2002–2003 (Enger et al., 2006). Eligible participants were males aged 44–71 years who had been Kaiser Permanente members for at least 1 year prior to study enrollment. Participants reported their race/ethnicity on a screening survey prior to the baseline survey. This information was used to create unique racial/ethnic categories for the following: Chinese, Japanese, Korean, Vietnamese, and Filipino. Participants who reported being Mexican, Central or South American, or any other Hispanic are defined as Latino regardless of other race or ethnicity reported and were removed from all other race/ethnic categories to avoid interference of Latino culture with Asian culture in our analyses. The Chinese population included people who were mixed races of Chinese and other races, while the categories of those reporting being Japanese, Korean, Vietnamese, and Filipino were mutually exclusive.

The baseline questionnaire collected information on demographics, acculturation, and anthropometrics and was completed by 8,634 Asian men (Chinese, Japanese, Korean, Filipino, and Vietnamese). Questionnaire data were linked with participants' electronic health records between 2005 and 2012 to extract information on weight and height measured at clinic visits.

We excluded participants with missing health records ($n = 528$ Chinese, 154 Japanese, 48 Korean, 388 Filipino, and 110 Vietnamese) and those with missing measured height ($n = 1$ Chinese). We also excluded participants with >73 clinic visits within the 8-year follow-up (top 1% of sample). These participants are assumed to have an illness that requires them to frequently visit their physician and may have experienced illness-related weight changes ($n = 16$ Chinese, 14 Japanese, 4 Koreans, 23 Filipino, and 2 Vietnamese). Finally, we excluded participants with missing information on income or education ($n = 141$ Chinese, 40 Japanese, 4 Korean, 72 Filipino, and 16 Vietnamese) leading to 3,325 Chinese, 1,088 Japanese, 263 Korean, 1,875 Filipino, and 522 Vietnamese included in the analyses. This study was approved by the Institutional Review Boards of Kaiser Permanente Northern and Southern California, and this secondary analysis was approved by Kaiser Permanente and University of North Carolina at Chapel Hill Non-Biomedical Institutional Review Boards on research involving human subjects.

Measures

BMI

Baseline BMI was calculated from self-reported weight and height. We extracted clinically measured weight and height from participants' health records (2005–2012). Height was not measured at all clinic visits and, on average, participants had 15 height measurements. To calculate BMI (kg/m^2) for each year of follow-up, we used each participant's average height from his first 15 clinic visits and average weight from each clinic visit within a year. Follow-up and definition of a year started with a participant's first weight measurement. The use of average annual weight avoids spurious influences from minor weight fluctuations. Each participant could have up to 8 BMI measurements. We dichotomized BMI into normal weight (18.5–24.9 kg/m^2) and overweight (≥25 kg/m^2). In secondary analyses, we also used the Asian-specific cut point for overweight (≥23 kg/m^2) (International Diabetes Institute, 2000). We calculated BMI changes between clinic visits and scaled them to 5-year changes. Time was calculated as the average age at each weight measurement within a year.

Indicators of acculturation

Information on acculturation was reported at baseline. The place of birth of participants and their parents was used to determine immigrant generation. First-generation includes foreign-born participants with foreign-born parents, second-generation includes US-born participants with at least one foreign-born parent and third-generation includes US-born participants with US-born parents.

Among foreign-born participants ($n = 4{,}991$) we also examined length of US residence and age at immigration. Duration of US residence was categorized into <10, 11–25, and >25 years. Age at immigration was calculated by subtracting duration of US residence from baseline age. Since duration of residence was assessed in categories, we estimated an age interval during which participants immigrated. We categorized participants into ≤40 and >40 years at immigration if both the lowest and highest possible age at immigration fell into the same category. In sensitivity analyses, we assigned observations with missing age at immigration to the highest possible age and then to the lowest possible age. This did not change our conclusions and we feel confident that these exclusions did not bias our results.

Statistical analysis

We used generalized estimating equation models to calculate odds ratios (OR) and 95% confidence intervals (CI) of being overweight comparing different levels of acculturation. Continuous BMI was analyzed using linear mixed models to estimate parameters of a 2-level hierarchical linear model (Heo et al., 2003) for BMI curves to calculate the difference in 5-year BMI change (95% CI) across different levels of acculturation. Separate models for each measure of acculturation were estimated. In the level 1 models, we regressed BMI on linear, continuous age at BMI measurement. We first evaluated 9-knot quadratic spline regression models (Witte and Greenland, 1997). Testing of successively simplified models showed that linear models were sufficient to describe the association between age and BMI across all ages in our study sample. In the level 2 models, we predicted the level 1 coefficients from the specific measure of acculturation and baseline age, annual household income (<$40 000, $40 000–59 999, $60 000–79 999, and ≥$80 000) and education (≤high school, vocational/some college, college graduate, and graduate degree). The error terms followed a normal distribution with a mean of 0. To determine if the observed associations were driven by differential BMI at baseline we also adjusted the level-2 models for self-reported BMI at baseline in sensitivity analyses.

In all analyses, we used an autoregressive order 1 covariance structure (Fitzmaurice et al., 2011; Hanley, 2003) and fit separate models for each indicator of acculturation. The most acculturated category was used as reference (i.e. third-generation, >25 years in the US and age at immigration of ≤40). An interaction by Asian subgroups indicated significant heterogeneity in the associations between acculturation and BMI over time, but not overweight. Thus, we presented results for all Asians combined for overweight, but subgroups-specific results for BMI change over time.

In analyses of length of US residence and age at immigration among foreign-born Asians, we also used US-born Asians as reference to determine at which level of acculturation the risk of increased BMI among foreign-born Asians is different from or similar to US-born Asians. Vietnamese were not examined separately in this analysis of BMI change since all Vietnamese participants were foreign-born. We used SAS Statistical Software (proc genmod and proc mixed), version 9.3 (Cary, NC). All tests and *P*-values were two-sided and considered statistically significant at $\alpha = 0.05$.

Results

At baseline, participants of each Asian subgroup were on average between 58 and 60 years old (Table 1). Less than 10% of Japanese, Koreans, and Filipinos but almost one-quarter of Vietnamese had less