IMPACT OF ACCULTURATION ON HEALTH BEHAVIORS AND BODY WEIGHT AMONG CHINESE INTERNATIONAL STUDENTS STUDYING IN THE UNITED STATES

By

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To my parents for supporting me pursuing higher education and for giving me selfless love
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<tr>
<td>ASSCS</td>
<td>Acculturative Stress Scale for Chinese Students</td>
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<td>DSQ</td>
<td>Dietary Screener Questionnaire</td>
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<td>FVL</td>
<td>all fruit and vegetables, including legumes and French fries</td>
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<td>FVLNF</td>
<td>healthy fruit and vegetables, including legumes but excluding French fries</td>
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<td>IPAQ</td>
<td>International Physical Activity Questionnaire</td>
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<td>VIA</td>
<td>Vancouver Index of Acculturation</td>
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<td>VIA-America</td>
<td>the score of how Chinese international students acculturate into American culture</td>
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<td>VIA-Heritage</td>
<td>the score of how Chinese international students maintain their heritage culture</td>
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<td>VIA-Integration</td>
<td>the score of how Chinese international students integrate two cultures</td>
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<td>VLALL</td>
<td>all vegetables, including legumes and French fries</td>
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<td>VLNF</td>
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To explore the impact of acculturation and acculturative stress on dietary intake, dietary behaviors, and body weight among international students in their sojourning experience from China to the United States.

This prospective observational study was conducted between August and December 2016 at a southeastern US university. Ninety-three Chinese university sojourning students (55 male and 38 female) were recruited in the study within their first month of arrival in the US. Upon enrollment, participants completed a series of questionnaires about their health behaviors in China and had their height and weight assessed. Anthropometric assessments and the same questionnaires were repeated in December with two additional questionnaires: the Vancouver Index of Acculturation and the Acculturative Stress Scale.

Participants experienced a significant decrease in their intake of dietary fiber, whole grains and vegetables, with a significant increase in the consumption of sugar, sugar-sweetened beverages, dairy and calcium when compared to reported intake in
China. Chinese students decreased the frequency of eating takeout foods, but consumed convenience foods more frequently. Students with a high degree of acculturation had a higher consumption of fiber, whole grain, fruit and vegetables in the US. Students with higher acculturative stress increased consumption of takeout food and skipped breakfast more frequently in the US compared with those reporting lower acculturative stress.

This 3-month prospective study found that Chinese international students had less healthy eating behaviors and diet intake after moving to the United States, and that acculturation, but not acculturative stress, was beneficial to Chinese students’ health behaviors. Findings from this study support the rationale for researchers and university administrators to provide supportive programs to reduce stress associated with acculturation and support healthy living for Chinese international students.
CHAPTER 1
INTRODUCTION

The number of international students studying in the United States increases each year. During the 2014/2015 academic year, 974,926 international students were studying in the U.S. (Institute of International Education, IIE, 2015). Among them, Chinese international students account for the majority, namely 31% of international students.

Studying and living outside of your home country is an excellent academic and cultural opportunity for many, but may come with challenges. Some obstacles of living and learning in an unfamiliar environment may give rise to numerous challenges, including linguistic, financial, interpersonal, and academic stressors, as well as differences in cuisine and culture. These stressors can contribute to anxiety, depression, loneliness, confusion, and physical illness (1). The level of stress experienced by studying in another country may depend on the degree of differences between one’s home culture and that of the study abroad country. For example, for students studying in the US, the stressors may be greater for students from Asia than for those from Canada or Europe because of the greater dissimilarity of ethnicity, culture and language. For example, a white Canadian student may integrate easily to the American culture compared with Chinese students, not only because they speak the same language, but also share a more common culture (2). Migrant epidemiologic studies consistently show positive associations between the risk of certain chronic diseases (like cancer, coronary heart disease, diabetes) and shift in lifestyle (3-5). Therefore, the health status of these populations become a critical public health issue.
Given that the physical and psychological changes during the acculturation process are thought to be the prominent contributors to chronic diseases (3, 5-9), public health initiatives should encourage immigrants to maintain healthy lifestyle behaviors from the traditional culture and/or adopt such behaviors from their host culture. The first step to achieve this is through a deeper understanding of if/how immigrant populations change their dietary and physical activity patterns as they acclimate to their host country, and how acculturation and psychological distress influence these adaptations.

However, different groups of immigrants may have diverse perspectives of the acculturation process and may change their behaviors differently from others in the same environment. For example, international students who are identified as sojourners, are more likely to return to their own countries or to be posted to another country after finishing school, so that they may desire to retain their traditional culture and beliefs, and hesitate to be fully involved in mainstream culture (10). On the other hand, permanent residents such as voluntary immigrants, refugees and asylum seekers, are assumed to stay in the U.S for a long time, even for their rest of lifetime; they are more eager to adapt to the American culture as soon as possible, and to be acknowledged by U.S-born Americans. Thus, nonpermanent-immigrant students may have a different acculturation experience from permanent immigrants, leading to different processes of adaptation. Berry, Kim, Minde and Mok (1987) measured acculturative stress levels among 1,000 individuals of different acculturating groups (voluntary and involuntary groups in Canada: there is no doubt that involuntary groups (Native Peoples and Refugees) have relatively high levels of acculturative stress, and voluntary groups (Immigrant and Ethnic Groups) experienced less stress. However,
sojourners, also a voluntary group, experienced greater stresses than other two groups, which provides the evidence that sojourners have the different perceived experience compared with permanent immigrants (11).

Thus, the goal of this study is to explore the impact of acculturation and acculturative stress on diet, dietary behaviors, physical activity, sleep, and body weight among university students moving from China to the United States.

This study is observational. Findings from this study may provide information for researchers and UF staff to provide supportive programs to reduce stress and support healthy living for international students in the future.

**Literature Review**

**Acculturation**

The process of adapting to a different culture is called acculturation (12). Acculturation encompasses all kinds of changes related to affective, behavioral and cognitive perspectives (13). Affective aspects of acculturation always refer to emotional and psychological shifts, including stress. Behavioral perspectives of acculturation include intercultural skills such as mastery of language and social rules or conventions. Cognitive perspective refers to the social identification. During the acculturation process, individuals tend to identify and classify themselves and others into distinct groups with different characteristics, like ethnic identity (14).

According to the degree to which individuals maintain their own heritage culture and also blend in with their new culture, Berry introduced four acculturative strategies, named respectively integration, assimilation, separation and marginalization (15, 16). Integration means that not only are individuals willing to regularly interact with people from their new culture, they keep in touch with individuals from their original culture.
While assimilation refers to those who are only interested in interaction with their new cultural group with little interest in maintenance of their original cultural contacts. In contrast, the separation strategy is used when individuals are averse to communicate with people in their new culture and inclined to remain engaged primarily in their own cultural activities. Marginalization is characterized by individuals with little interest in interaction with others from either their heritage or new culture. Different acculturating strategies influence the outcome of how well people adapt to a new culture. Research supports that a strategy of integration is associated with better psychological and sociocultural adaptation, especially among young immigrants (2, 17).

Integration may be the most positive strategy because individuals that integrate have the opportunity to compare two different cultures and absorb the essence from each, resulting in a better adaptive outcome: lack of depression and anxiety, dealing well with problems and positively contacting with national peers in the society they reside. However, psychological and sociocultural health cannot be confused with physical health, which means better adaptation is not equal to a healthier physical status or less disease. In fact, many studies found an inverse relation between acculturation to Western World countries and physical health (18, 19). Although immigrants have lower risk of smoking, developing obesity, hypertension, and other chronic diseases than US-born whites (20), the longer immigrants stay in the new host country; the poorer health outcomes they experience (21-23). Mexican descendants born in the U.S suffered from mental health problems to a greater extent than did their parents who immigrated to the United States (24). Chinese and Japanese immigrants to the US are at higher risk of several types of cancer, like colon cancer, breast, and
prostate cancer than native Chinese and Japanese while migration decreased the risk of stomach cancer (6, 25). Migrants to the U.S. from China (26, 27), Japan (28) and Mexico (29) also experienced an increased rate of cardiovascular diseases and other associated diseases, like hypertension, diabetes, and hypercholesterolemia (30, 31). Moreover, these risks were independently related to increased energy intake, physical inactivity and body mass index. A similar study also found an increased risk of coronary heart disease (CHD) for Japanese immigrating to California. The risk of CHD was lowest among Japanese in Japan while highest in California. What’s more, low acculturation seems to blunt this risk of CHD as people tending to Westernize were three- to five-fold more likely to suffer from coronary heart disease (32). Interestingly, even though lower acculturated Latinos have less opportunities to access health care services, Amaro and de la Torre (2002) stated they are less at risk for health problems (33), which, once again, explains the strong positive relationship between low acculturation and health outcomes.

The physical and psychological changes during the acculturation process, including dietary pattern, dietary habits, physical activity, stress and sleep time, contributed to the above diseases (6).

**Body Weight**

Previous reports have documented that immigration to the US leads to weight gain, with increasing length of residence resulting in greater increases among different immigrant subgroups (18, 34). A systematic review assessed fifteen studies, 14 of which supported the positive relationship of duration of residence in US and increasing body mass index (35). A cross-sectional analysis from the 2000 National Health Interview Survey, found the threshold of weight gain would be after 10 years of
residence in the US, and the prevalence of obesity of immigrants residing in the US for at least 15 years would approach that of US-born adults (18). What’s more, younger immigrants are more likely to become obese with the increased length of residence in US compared to older immigrants (36). Once immigrants become obese, they too would likely experience the complications of obesity such as cardiovascular diseases, type 2 diabetes, hypertension, and so on. This may explain in part why the immigrants have an increased risk of chronic diseases after immigration. On the other hand, the association between residence duration in the host country and increase in BMI may vary by ethnic backgrounds. A systematic review indicated that the proposed relationship between increased BMI and increased length of residence in western cultures (US, Canada, Norway, and Netherlands) held true for Hispanic, European and African immigrants. This relationship is not consistently observed however among Asian immigrants to the same cultures with only 13 of 34 studies finding a positive association (37).

**Dietary Patterns in Two Cultures**

A Western diet is characterized by frequent intake of red meat, refined carbohydrates, high-fat dairy products, butter, desserts, sugar-sweetened beverages and processed and fast foods, like French fires. Such high-fat, high-sugar, high-calorie foods, combined with low physical activity, contribute to obesity (38) in developed countries, and subsequently metabolic and cardiovascular diseases (39). In contrast, a traditional Chinese diet includes a mix of plant-based foods that are primarily vegetables, rice, and noodles with a small amount of meat. Instead of sugar-sweetened beverages and high-sugar desserts, a traditional Chinese diet includes hot tea with nuts, melon seeds and small portions of sweets. These distinct dietary patterns may partly explain the low prevalence of obesity in China (2.9%) compared to that of the
United States (33.9%) (WHO, global database on body mass index, http://apps.who.int/bmi/index.jsp).

**Dietary Acculturation**

Immigration to the Western countries predisposes immigrants to weight gain and potential chronic diseases commonly attributed to the dietary acculturation (5, 40). Dietary acculturation is defined as the process of adjusting to a dietary pattern of the host country.

Immigrants gradually adapt their diet to a more Western style diet after moving to North America. A study showed the post-immigration diet of Asians living in Nevada for at least 6 months is higher in fat (especially saturated fat and monounsaturated fat), lower in carbohydrate and fiber than their pre-diet after Asian immigrants move to Nevada for at least 6 months (3). Pan et al. (41) found that Asian students (who have been living in the US for at least 3 months) skipped meals more frequently (especially breakfast); consumed more fats, sweets, dairy products and less vegetables and meat after living in the United States. They also chose saltier and sweeter snack foods and chose fast food more often when eating out. In contrast, another study of South Asian immigrants to Canada, reported both positive and negative dietary changes. South Asian immigrants increased their consumption of fruits and vegetables and food preparation methods, but also increased consumption of fast foods, sugar-sweetened beverages and red meat (42). Pan’s study also reported an increased intake of fruits (41)

Furthermore, changes in dietary patterns differ among immigrants by the level of acculturation. Less acculturated Latinos had a higher intake of fruit, beans and rice, with lower consumption of sugar and sugar-sweetened beverages compared with their more
acculturated counterparts after moving to the US (43). The length of living in the US and English proficiency are two common markers used in research for assessing degree of acculturation. Study in Pennsylvania found Chinese-American with longer period residing in the US and with better English consumed more fats/sweets and soft drinks, although consumption of fruits and vegetables also increased to some extent (44). Similarly, Chinese women in Canada and America with a high level of acculturation had higher consumption of fat, fruit and vegetable than those with a lower score (45). Another study of 312 Chinese immigrant women in Philadelphia it was also found that a higher acculturation level (indicated by length of US residence) was significantly associated with increased intake of energy-dense diet from fat, sugar, and with decreased dietary moderation score; moderation value indicates the intake of total fat, saturated fat, cholesterol and sodium, and it therefore could be a contributing factor to increased incidence of chronic diseases (46). A similar result was found in a cross-sectional study of South Asian immigrants in US, dietary fat (e.g. saturated fat and trans fat, dietary cholesterol and n-6 fatty acid) and length of US residence were positively associated (47).

**Physical Activity**

Regular physical activity has many health benefits including a reduced risk of cardiovascular disease, type 2 diabetes and metabolic syndrome, several types of cancers (colon and breast cancer) and obesity. Regular physical activity also strengthens your muscles and bones, improves mental health and even prolongs life (48).

An international study compared the prevalence of physical activity among 20 countries, including U.S. and China, using IPAQ to assess PA participation. It reported
that 6.9% of Chinese and 15.9% of American adults were physical inactive, while 57.7% of Chinese and 62% of American were highly active. What’s more, Chinese were more likely to participate in walking-intensity activity which accounts for about 55% of total physical activity, while American preferred vigorous-intensity activity (more than 50% of total). It is consistent to another study which found 66.3% of Chinese adults are physically active (49). However, it also reported that almost 63.3% of Chinese participated in work-related physical activity while only 24.5% in leisure-time physical activity (50).

Research on the impact of immigration to the US on physical activity patterns is mixed. In terms of leisure time physical activity (LTPA), the rate of Asian Americans who do not meet the recommendation of LTPA is much higher than US-born non-Asians; whereas there was no difference in non-leisure time physical activity (NLTPA) between Asian Americans and non-Asian Americans (30). Yon et al. compared physical activity among international students in U.S., and found Asian female college students only take 1.3 hour/week physical activity, which is much lower than other groups. As the result, Asian population have been identified as one of the most physically inactive groups. Contrary to the prevailing view that immigrants tend to have a secondary lifestyle with increasing the length of US residence (20), some studies showed immigrants became more physically active after coming to the US. By exposure to the highly physically active social norm, LTPA level among such immigrants increased with years of living in the US increasing (30). Tremblay et al. found a similar response when examining activity habits of immigrants to Canada. Canadian born non-immigrants were the most physically active, followed by long-term immigrants (>10 years), and activity was the
lowest among recent immigrant (≤10 years), indicating that immigrants tend to become
more physically active after immigration(51).

However, it is not paradox that immigrants become more vulnerable to chronic
diseases and obesity even though they are more physically active, because their
physical activity level is still lower than that of American students. Statistics showed
Asian female college students only take 1.3 hours/week of physical activity, which
stands in sharp contrast to the amount of physical activity among North American
female students with 3.3 hours per week (52). Furthermore, other factors, such as diet,
stress and sleep, combined with physical activity, may contribute to the susceptibility of
diseases as well.

**Acculturative Stress**

Exposure to an unfamiliar environment may give rise to numerous challenges,
including linguistic, financial, interpersonal, and academic, as well as differences in
cuisine and culture in U.S (53). Acculturative stress arises when an individual does not
have the ability to cope with such challenges by simply shifting their behavior, making
them anxious, depressive and confused (54).

Different from cultural shock which only refers to the negative aspect of
immigration, acculturative stress is associated with both positive (eustress) and
negative (dis-stress) situations and one’s perception and response to a situation (Berry,
2006). However, most researchers describe acculturative stress as merely negative,
because it has been demonstrated to be associated with diminished mental health and
well-being (11, 55), including weight gain (56, 57) and obesity (58).

Stress contributes to mental and physical diseases commonly attributed to
stress-related unhealthy behaviors. Zillmann and Bryant declared that people under
stress were more likely to turn to unhealthy dietary and physical behaviors (59).

Emotional eating - a behavior of overeating - occurs when an individual is under stress and attempts to relieve the negative emotion. Emotional eaters often over-consume “comfort foods”, or foods rich in fat and sugar for the purpose of alleviating a negative emotional state (60, 61). Studies showed that stress is highly related to consumption of palatable non-nutritional foods (62), such as high fat intake, sweet foods and more frequent fast food (60, 63-65). However, the relationship between stress and eating is too complex to get a common conclusion. The relationship between stress and food intake depends on the severity of stress and may vary by sex. Some human (66) and animal (67, 68) studies showed food consumption is decreased with the increased severity of stress (58). One study showed that men under a stressed condition ate less than those in a control condition, while there was no significant difference of eating patterns among women, indicating gender effect on the relationship of stress and eating (69).

Physical activity (PA), which supports mental health, is also influenced by stress reciprocally. Stults-Kolehmainen M A in 2014 (70) systematically reviewed 55 prospective studies related to stress and physical activity. Of the 55 studies, the large majority of studies (76.4%) concluded a negative effect of stress; that is stress resulted in less exercise. Only 18.2% of studies found a positive outcome: stress makes people more physically active.

Stress, on the other hand, has been characterized as a key contributor of sleep disturbances (71-74), such as poor sleep quality (Alsaggaf, Wali, Merdad, & Merdad, 2016), insomnia (74) short sleep duration (Vgontzas et al., 2008), sleep deprivation
(Alsaggaf, Wali, Merdad, & Merdad, 2016) and so on. Stress-related sleep disturbances subsequently impair brain functions, alter neuroendocrine immune, cardiovascular and metabolic system, and finally impact physical and mental health. Furthermore, previous epidemiologic and experimental articles have shown the strong link between sleep deprivation and obesity (75). Even a single night of sleep loss could increase hunger and appetite by disturbing endocrine regulation of energy homeostasis, contributing to increased weight gain (76).

Many studies have demonstrated that stress leads to the stress-induced eating, characterized by the consumption of foods high in fat, sweets and fast foods; stress is a contributor to physical inactivity, which was supported by majority of studies; and stress is also related to the sleep disturbance. Most studies examining stress and health behaviors have examined work-related stress. Few studies have focused on the relationship of acculturative stress and eating, physical activity or sleep. Only one study examined the impact of acculturative stress on dietary behaviors, suggesting that acculturative stress increased the consumption of fat and energy-dense foods with no affect the overall intake of energy (53, 77).

Conclusions

1. Acculturation may contribute to increased risk of chronic diseases and obesity, which may be associated with the changes in eating patterns, dietary habits, physical activity and stress.

2. Immigrants change their eating patterns and eating behaviors after moving to the United States, favoring high fat and sweet foods and convenience foods. However, the change of amount of fruits and vegetables consumption is controversial.

3. Immigrants may become more physically active after moving to the United States. However, most studies do not classify the different types of physical activity, which lead to controversial results: some conclude that immigration increases the sedentary behaviors, while others found an increase in physical
activity. Future researches should examine how immigration affects different types of physical activity.

4. Numerous studies showed that stress was associated with decreased dietary habits, physical activity and sleep, and overall diminished physical health. However, few articles focus on the relationship of acculturative stress with diet, physical activity, and body weight among international students. Research should regard acculturative stress as a vital factor which impacts health behaviors and body weight during the process of acculturation.

Limitations of Previous Studies

International students who are identified as sojourners have different perspectives and responses to the process of immigration from other immigrants, thus studies of international students’ health behaviors after immigration are necessary. Although previous publications have reported how immigration affects the dietary and physical activity habits of international students, few studies have truly examined the relationship of health behaviors and acculturation with the focus on international students because the level of acculturation in previous studies is commonly indicated by the length of US residence rather than a direct measure.

Existing literature includes many reports of immigrants that have been living in the US for a long period of time; studies focusing on the short-term impact of acculturation on recent immigrants’ health status are limited. However, recent immigrants are more likely to suffer from cultural shock, stressors and discrimination due to the maladjustment when first integrating to the US. Thus long-term behaviors are not necessarily representative of behaviors during this initial period. The early stage of acculturation is critical for developing behavioral habits. Thus, it becomes essential to study the effect of short-term immigration on the development of health behaviors, like dietary pattern, dietary habits, and physical activity.
Research Aims

To address these gaps in the literature, this project seeks to document changes in health behaviors and body weight of Chinese international students during their first year of studying in the US and to explore how these changes may be moderated by acculturation and acculturative stress. The following three aims and hypotheses are proposed to achieve this goal:

Research Aim 1: To identify how the process of immigration affects health behaviors and body weight among international students from China to the US.

- Hypothesis 1: International students will change their eating pattern to unhealthier direction after moving to the United States. It is expected that international students will experience 1) decrease in fruit and vegetable intake, 2) decrease in fiber intake, 3) increase in dairy and calcium consumption, 4) increase in consumption of sugar and SSB as well as 5) a decrease in whole grain.

- Hypothesis 2: It is expected that international students are more likely to engage in unhealthy dietary behaviors after moving to the United States, such as skipping breakfast, increased consumption of convenience/takeaway food and eating outside of the home more frequently.

- Hypothesis 3: International students will become more physically active after moving to the United States.

- Hypothesis 4: International students will sleep less after moving to the United States.

- Hypothesis 5: International students will gain weight after moving to the United States.

Research Aim 2: To examine how acculturation stress and acculturation predict health behaviors and body weight among international students from China to the US.

- Hypothesis 1: Chinese international students with higher ratings of acculturative stress are expected to have unhealthier dietary patterns and eating behaviors, to be less physically active, to have less sleep time and gain more weight, compared with immigrants reporting less stress.

- Hypothesis 2: Chinese international students with a higher acculturation level are expected to have unhealthier dietary patterns and eating behaviors, to be more
physically active, to have less sleep time as well as to gain more weight, compared with less acculturated immigrants.

Research Aim 3: To examine how acculturative stress moderates the relationship of acculturation with health behaviors and body weight.

- Hypothesis 1: The association of acculturation with dietary pattern, eating behavior, physical activity, sleep time and body weight is more significant among Chinese international students with more acculturative stress.
CHAPTER 2
MATERIAL AND METHODS

Study Design

This prospective observational study recruited Chinese international students who were planning to study at University of Florida (UF) for their undergraduate bachelor’s degree, Master or PhD degree in fall, 2016. Potential participants were recruited through several outlets including chat apps such as Facebook and WeChat that are commonly used by international students, printed flyers and face-to-face meeting during check-in day at UF International Center. Interested participants contacted research staff and were directed to a Qualtrics™ link that asked the 5 eligibility questions. Qualtrics™ is a software created by Qualtrics company, with the function of online data collection (78) and analysis including marketing & brand research, customer satisfaction, product and concept testing, employee evaluations and website feedback (79). Eligibility criteria include 1) being 18 years of age or older; 2) have not lived outside of China for more than 3 months at any time in their life; 3) speak Chinese as first language; 4) acceptance to attend the University of Florida as an undergraduate or graduate student in fall 2016; 5) for females, not currently pregnant or planning on becoming pregnant in the next year. The response option for each question was Yes or No. If a response indicated the participant did not qualify, a message would pop up notifying the participant that they were not eligible. If they did qualify based on responses, participants would then be asked to leave their name, gender, phone number and UF email address. Study staff contacted each eligible person through email. The email provided each person with their specific participant ID and another Qualtrics link that first presented them with the consent form and then baseline
questionnaires. Questionnaires included Basic Demographic Questionnaire, Dietary Screener Questionnaire (DSQ), International Physical Activity Questionnaire (IPAQ) and Dietary Behavior Questionnaire (DBQ). After finishing the questionnaires, they were asked to take height and weight assessment by study research assistants. All questionnaires and assessments were finished within the first month of their arrival at UF, that is in Aug/Sep, 2016 - Point 1. At the end of the first semester (Nov/Dec, 2016 - Point 2) here at UF, participants had their height and weight reassessed and repeated the DSQ, IPAQ, DBQ again, a revised version of Basic Demographic Questionnaire that include questions about living in the US, and two additional questionnaires, the Acculturative Stress Scale for Chinese Students (ASSCS) and the Acculturative Index Questionnaire (VIA). Participants were compensated $10 in Gator Dining coupons at each of the two in person assessment visits. These coupons could be used at any dining facility on campus.

The recruitment email and postings, consent form, and all questionnaires were presented in both English and Chinese at each time point. Separate links was created in Qualtrics for Chinese students to reduce confusion. All documents were translated and back translated and are provided in the Appendix.

**Demographic Characteristics**

There were 21 items in Basic Demographic Questionnaire (before coming to the US) and 7 items in Basic Demographic Questionnaire-after coming to the US, respectively. These questions are taken from various questionnaires and ask basic facts such as age, sex, country of origin, major of study, marital status, economic standing of the family, self-ratings of oral and written communication skills in English TOEFL score and so on. In the Basic Demographic Questionnaire (after coming to the US), questions
about living situation in the United States were involved, for example: “where do you live in currently” and the choices would be “on campus” or “off campus”, “if you are married, does your spouse/significant other live with you?”, “how many roommates do you have currently” and “do you have relatives in Florida?” Questions about food accessibility were assessed in both before and after Questionnaires with the question “which of the following statements best describes the food eaten in your home (when you were in your home country or after you moved to the United States)?” One sleep question, taken from the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) was assessed with the question “Once you have fallen asleep, how long did you sleep for?” in both Questionnaires were asked pre and post.

**Dietary Pattern**

Participants completed Dietary Screener Questionnaire (DSQ) in the NHANES 2009-10 (80) to assess the dietary patterns. The DSQ is a 26-item questionnaire that asks about frequency of consumption of various foods and food groups, including fruit and vegetables (cup/day), fiber(g/day), dairy(cup/day), calcium(mg/day), sugar(tsp/day), added sugars from sugar-sweetened beverages (tsp/day), and whole grains (oz/day). Each component was scored separately. In order to better meet Chinese dietary pattern, some foods that are not common in those countries were replaced by the alternatives that are eaten regularly in China. For example, when asking about the frequency of cereal intake, considering that cereal is not very common in China, we added porridge and oatmeal in the Chinese-version Questionnaire. Besides, we asked about the frequency of dishes made with tomato instead of Mexican-type salsa which is relatively uncommon in China.
Although the DSQ is not as accurate as the 24-hour dietary recalls, DSQ is broadly used when time a limiting factor in the study and when there is no requirement for evaluating the total diet. The DSQ instrument is most useful in following situation: 1) characterization of the average intake of the population; 2) distinguishing the population with high intakes from those with low intakes; 3) identification of the relationship between diet and other variables. One of goals in this study is to identify how process of immigration, acculturation and acculturative stress related to dietary pattern, so using DSQ as a dietary assessment instrument is sufficient to achieve the goal in our study.

**Physical Activity**

Physical activity was measured by self-administered International Physical Activity Questionnaire (IPAQ) long version in English (81)- a 27-item questionnaire that asks about time and intensity of physical activities completed for recreation, work, transportation, and household domains. According to the Guidelines for Data Analysis of the International Physical Activity Questionnaire (IPAQ) in 2005 (Committee., 2005). The score of physical activity is expressed as MET-min per week (MET level \* minutes/day \* days/week). MET levels are different among different types of activity. 3.3 METs, 6.0 METs, 4.9 METs and 8.0 METs represent walking, cycling for transportation, moderate (Mod) and vigorous (Vig) intensity, respectively. The protocol of IPAIPAQ was developed in 1998 by the World Health Organization (http://www.ipaq.ki.se) and was tested across 12 countries (14 settings) in term of reliability and validity in 2000(Craig et al., 2003). The reliability and validity of Chinese version of IPAQ (both long vision and short vision) has been demonstrated in previous study focusing on the Chinese college students (Qu & Li, 2004).
The reasons of using IPAQ assessment in this study are: 1) many other measurements focus on leisure-time activities only, however, IPAQ enables all dimension of health-related physical activities so that the level of physical activity could be compared at the same domain. 2) IPAQ is suitable for adults aged from 15-69 years old, which includes college students. 3) IPAQ was developed in response to the global comparisons and to international surveillance. So it becomes easy when levels of physical activity are compared among different groups of population. IPAQ has been widely used to compare the PA behavior across countries. Bauman and his colleagues used IPAQ to compare the prevalence of PA participation in 20 countries (Bauman et al., 2009). Guthold and his colleagues collected the data from World Health Survey and analyzed the prevalence of physical inactivity in 51 developing countries through the use of IPAQ (Guthold, Ono, Strong, Chatterji, & Morabia, 2008). Sallis used the IPAQ short version to analyze data when examining the role of neighborhood environments on physical activity in 11 countries (Sallis et al., 2009).

Dietary Behaviors and Sleeping Behavior

The Dietary Behavior Questionnaire included 7 questions taking from various questionnaires, asking about the frequency of consuming takeaway food, convenience food and eating outside of home (never, <1 meal/week, about 1 meal/week, ≥ 2 meals/week), the frequency of breakfast (always, often, seldom/never), the number of meals per day (≤ 2 times, 3 times, or 4 times), the frequency of shopping food (Yes or No) and cooking meals at home (daily, 3 times/week, 1 time/week, rarely). Each question was analyzed by itself.
Acculturative Stress

Acculturative stress was assessed by Acculturative Stress Scale for Chinese Students (ASSCS) which was developed by Bai (Bai, 2016). The questionnaire has been demonstrated as reliable and validated tool to assess acculturative stress among a Chinese student sample in the United States (Bai, 2016). The present study has received permission for using ASSCS from Bai. It was a 32 item Likert Scale questionnaire to assess stress related to being an international student. The subscales include language insufficiency, social isolation, perceived discrimination, academic pressure and guilt toward family. The score of acculturative stress was calculated by the mean of the all items.

Acculturative Index

The level of acculturation was assessed by the combination of 20 questions from Vancouver Index of Acculturation (VIA) related to the individual’s attitudes, behaviors, values and cultural identity (Ryder, Alden, & Paulhus, 2000), and the other 7 questions which are more related to academic problem. Vancouver Index of Acculturation is a bi-dimensional instrument, that is, it assesses both of original culture-heritage culture, and new culture-mainstream culture, which was consistent with Berry’s acculturation strategies (16). It involves changes in attitudes, behaviors, values and cultural identity. The reason why we choose this questionnaire is: 1) unidimensional perspective could not distinguish integration from assimilation, and separation from marginalization. In this model, immigrants are assumed to acquire values, beliefs, norms, cultures and activities from the mainstream culture and discard those from heritage culture. However, as sojourners, most of international students will go back to their home countries after finishing school. It is impossible to discard whole values from home country and
therefore the unidimensional model is not suitable to the study; 2) VIA is relatively brief compared with other bi-dimensional measurements. 3) the validity and utility of the VIA has been demonstrated by the previous study (Ryder et al., 2000), and the result of this study suggested that VIA is a reliable measurement for assessing bi-dimensional model in several ethnic groups, especially in ethnic Chinese.

In order to measure the acculturation index, level of acculturation was divided into three scores: VIA-Heritage, VIA-American, VIA-Integration, according to the guidelines from Goforth, A. N. (Goforth, 2011). Ac-Heritage is calculated by the means of items related to Heritage Culture (MH). Ac-American is calculated by the means of items related to American Culture (MA). Ac-Integration is created to meet the integrated acculturation strategy, which involves the participants’ attitude to both culture. High score of VIA-Integration means that they favor both culture while low score means they prefer one or neither. VIA-Integration is calculated by MH \times MA.

**Anthropometric Measures**

Height and weight were assessed in a private room in the Food Science and Human Nutrition department. Every effort was taken to have a research assistant of the same sex take these measures. Height was measured in triplicate, with shoes off and hair down and weight was measured in triplicate on a calibrated digital scale.

**Statistical Analysis**

All data were analyzed using SPSS. Data were analyzed at both baseline and at the end of the first semester.

**Sample Size**

We used body weight change after immigration as the primary outcome in this study. As a previous study found a significant weight increase of 2.79±5.9 lb after 12
weeks of studying in the US (40) among international college students from different countries and with an expected 20% attrition rate, 90 participants were needed to detect a significant change. In our study, we planned to recruit 100 Chinese new students. Each year approximately 1400 students from China come to the University of Florida. Enrolling 90 Chinese students will ensure adequate sample size to complete this project.

**Primary Analyses**

**Aim 1:** A prospective research design was used to assess how immigration of international students to the US affects their basic health behaviors (diet, physical activity, sleep) and body weight.

Paired t-tests were employed to investigate the differences in dietary patterns, physical activity and weight status before and after moving to the United States. Wilcoxon Signed Ranks Test was used to assess the differences in eating behaviors (except shopping question which was assessed by Chi-square) between time residing in China and in the United States.

**Aim 2:** A cross-sectional study design was used to assess how acculturation predicts health behaviors and body weight among participants by using data from second time point (at the end of their first semester). Pearson correlations and Spearman correlation were conducted between the predictor variables (VIA-Heritage, VIA-American, VIA-Integration, Acculturative Stress) and outcome variables of interested (dietary pattern, dietary behavior, physical activity, sleeping time and body weight). Linear regression was then used to assess the ability of acculturation and acculturative stress to predict the outcome variables where significant correlations found.
Aim 3: A hierarchical regression model was used to assess the interaction effects of acculturation and acculturative stress on outcome variables. The interaction was interpretable only if the regression coefficient for the product term was significant in the regression equation (Baron & Kenny, 1986). Then simple slope was plotted according to Dawson’s recommendation (Dawson, 2014). Scores of VIA-America and Acculturative Stress were standardized prior to testing.
CHAPTER 3
RESULTS

At the recruitment period, 151 Chinese new students at University of Florida were interested in the study and filled out the Screener Questionnaire. Among them, 31 students were not qualified and 26 students did not finish the follow up questionnaire at the first time point (at the beginning of their semester) resulting in 94 participants enrolled in the study. During the study, 1 male participant dropped out from the study at the second point (the end of their first semester), leaving 93 participants that completed all questionnaires and assessments at both time points.

Demographic Characteristics

Ninety three (55 male and 38 female) Chinese new students (mean age 23.6 + 1.67 yrs) studying at University of Florida participated in the study. One participant was from Taiwan, and all others from mainland China. The participant was interviewed regarding his heritage culture, self-identified as Chinese and was thus included in the analysis. The demographic characteristics of participants are shown in Table 3-1. Four fifths of participants were graduate students, and almost half of them were majoring in Engineering.

Research Aim 1

To identify how the process of immigration affects health behaviors and body weight among international students from China to the U.S.

Preliminary Analysis

The outliers were deleted from the data analysis. As for dietary patterns, there were 8 outliers removed from the total, leaving 85 in total. Outliers were defined as having a score greater than or equal to 3 standard deviations above or below the mean score.
And in the physical activity part, we removed 6 outliers from total population, collecting valid data from 87 participants.

**Dietary Patterns**

Chinese international students experienced significant decreases in the consumption of all food groups except fruit after coming to the United States (Table 3-3).

**Eating Behaviors**

Chinese international students decreased the frequency of eating takeaway foods significantly, but consumed convenience foods more frequently. There were significant increases in the frequency of shopping for foods and cooking at home after coming to the United States (Table 3-4)

**Physical Activity**

Table 3-5 showed that Chinese international students significantly decreased their amount of physical activity after coming to the U.S. By comparing three types of physical activities (Walking, Moderate, Vigorous) within single time point, the ANOVA and Post Hoc Test showed that Chinese students did Walking-intensity activity much higher than Moderate- and Vigorous-intensity physical activity in China, while there was no difference among three intensities when they were in the United States.

**Sleeping Duration**

Chinese international students slept less after coming to the U.S. (Table 3-6)

**Body Weight**

Only female Chinese students gained body weight significantly after coming to the US. (Table 3-7)
Research Aim 2

To examine how acculturation stress and acculturation predict health behaviors and body weight among international students from China to the U.S.

Preliminary study: The data from second time point (in US) was used in this aim. Spearman correlation was used to identify the relationship between demographic characteristics and healthy behaviors and body weight in US (Table 2.2.0). Numeric variable (age) and dichotomous variables including Gender (male=0, female=1), Education (graduate=0, undergraduate=1), Relationship (single=0, in a relationship=1), Location (on campus=0, off campus=1) were directly entered in the model. Other variables with more than two levels were dummy-coded.

Dietary Pattern

As gender was significantly associated with consumption of food intake (Table 3-8), partial correlation was used to determine the correlation of acculturation (VIA-Heritage, VIA-America, VIA-Integration) and acculturative stress with average consumption of food groups among Chinese international students studying in US, by controlling for gender (Table 3-9). Variables with significant correlation were entered in linear regression model as predictor of acculturation or acculturative stress variable and dependent variable of consumption of food groups, to determine the prediction effect of acculturation and acculturative stress on the average consumption of food groups. After holding gender variable constant, VIA-America was highly associated with the higher consumption of fiber, whole grain, all fruit and vegetables, healthy fruit and vegetables, all vegetables, healthy vegetables, as well as fruit. For each unit increase in VIA-America, there were an increase in fiber consumption of 0.4 cup/day, in whole grain consumption of 0.04 oz/day, in all fruit and vegetables consumption of 0.1 cup/day, in
healthy fruit and vegetables consumption of 0.1 cup/day, all vegetables intake of 0.1 cup/day, healthy vegetables intake of 0.1 cup/day, as well as an increase in fruit consumption of 0.1 cup/day. VIA-Integration was highly related to the higher consumption of all vegetables intake, healthy vegetables intake, and sugar intake; for each unit increase in VIA-Integration, the dependent variables would increase by 0.006 cup/day and 0.006 cup/day, and 0.076 tsp/day respectively. However, after controlling gender, neither VIA-Heritage nor acculturative stress was not associated with any of food groups intakes.

**Eating Behaviors**

There were few correlations between demographic characteristics and eating behaviors among Chinese students living in US. Due to small sample size in subsets, demographic characteristics were not considered in the further analysis.

Table 3-10 showed the correlation between independent variables (VIA-Heritage, VIA-America and VIA-Integration and acculturative stress) and dependent variables (eating behaviors). Acculturation scores were not related to any of eating behaviors, while acculturative stress was highly associated with more frequent eating of takeout foods. Acculturative stress was also related to eating breakfast less frequently and decreased number of meals per day.

**Physical Activity**

Similar to eating behaviors, demographic characteristics did not impact the amount of physical activity. Table 3-11 showed the correlation between independent variables (VIA-Heritage, VIA-America and VIA-Integration and acculturative stress) and dependent variables (physical activity in US). Every 1 point increment in VIA-Heritage was related to a decrease in physical activity of 64.7 MET-minutes/week in
transportation domain. Every 1 point increase in VIA-America was associated with an increase in physical activity of 155 MET-minutes/week in work domain and was associated with an increase of walking intensity of 141.4 MET-minutes/week.

**Sleeping Duration**

There was no correlation among predictors (acculturation and acculturative stress) and sleeping duration among Chinese international students living in US (table 3-10).

**Body Weight**

There was no correlation among predictors (VIA-America, VIA-Heritage, VIA-Integration, and acculturative stress score) and body weight (Table 3-12).

**Research Aim 3**

To examine how acculturative stress moderates the relationship of acculturation with health behaviors and body weight.

**Dietary Pattern**

The hierarchical regression was applied in order to test the effect of interaction of acculturation and acculturative stress on the changes in mean consumption of food groups from baseline. The standardized predictor (acculturation) and standardized moderator (acculturative stress) were entered at the first step, and the interaction term (acculturative stress [standardized] * VIA-America [standardized]) were entered at the second step. The interaction term was interpretable only if it was statistically significant in the regression model (82). Table 3-13 showed that interaction was only significant for the change in whole grain intake, which indicated that acculturative stress score had a moderation effect on the relationship between acculturation and the change in whole grain intake from baseline. What’s more, the moderation effect did not reach
significance in terms of the average change in consumption of fiber, all vegetables, healthy vegetables since their p value are close to 0.05. The negative coefficient of the interaction term suggested that the association between acculturation and the change in whole grain intake from baseline becomes more positive as acculturative stress decreases. According to Dawson’s recommendation (83), the predicted relationship (“simple slopes”) between the predictor (acculturation) and the dependent variable (change in whole grain intake) was plotted when the level of moderator (acculturative stress) and the level of predictor (acculturation) were one SD below and above the means. Simple slopes were not tested because there were no meaningful values of acculturation score to choose; using arbitrary values of the moderator, such as one standard deviation above or below the mean, makes no sense in any way, suggested by Dawson (83).

**Other Outcome Variables**

The moderation effect of acculturative stress on the relationship between acculturation and other outcome variables (eating behaviors, physical activity, sleeping duration and body weight)—either the changes from China to US or the original data from US, were very weak, so further analysis and results were reported here.
Table 3-1. Demographic characteristic of Chinese international students

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>55 (59.1)</td>
</tr>
<tr>
<td>Female</td>
<td>38 (40.9)</td>
</tr>
<tr>
<td>Student Status</td>
<td></td>
</tr>
<tr>
<td>Undergraduate</td>
<td>18 (19.4)</td>
</tr>
<tr>
<td>Graduate</td>
<td>75 (80.6)</td>
</tr>
<tr>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Agricultural Sciences</td>
<td>12 (13)</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Business/Communication</td>
<td>5 (5.4)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3 (3.2)</td>
</tr>
<tr>
<td>Education</td>
<td>6 (6.5)</td>
</tr>
<tr>
<td>Engineering</td>
<td>43 (46.2)</td>
</tr>
<tr>
<td>Fine Arts/Humanities</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Health/Nursing</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>3 (3.2)</td>
</tr>
<tr>
<td>Undeclared</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>Others</td>
<td>15 (16.1)</td>
</tr>
<tr>
<td>Marital Status in U.S.</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>51 (54.8)</td>
</tr>
<tr>
<td>In a committed relationship</td>
<td>35 (37.6)</td>
</tr>
<tr>
<td>Married</td>
<td>0</td>
</tr>
<tr>
<td>Economic Standing of Family</td>
<td></td>
</tr>
<tr>
<td>Lower than average income</td>
<td>6 (6.5)</td>
</tr>
<tr>
<td>About average income</td>
<td>71 (76.3)</td>
</tr>
<tr>
<td>Higher than average income</td>
<td>16 (17.2)</td>
</tr>
<tr>
<td>Financial support</td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>79 (83.2)</td>
</tr>
<tr>
<td>Themselves</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Home country or work place</td>
<td>4 (4.2)</td>
</tr>
<tr>
<td>U.S. government or foundation</td>
<td>4 (4.2)</td>
</tr>
<tr>
<td>A research grant or UF faculty</td>
<td>5 (5.3)</td>
</tr>
<tr>
<td>Location of Living at UF</td>
<td></td>
</tr>
<tr>
<td>On campus</td>
<td>20 (21.5)</td>
</tr>
<tr>
<td>Off campus</td>
<td>73 (78.5)</td>
</tr>
</tbody>
</table>
Table 3-2. English level by TOFEL score and self-rated English evaluation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Listening</th>
<th>Speaking</th>
<th>Writing</th>
<th>Reading</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOFEL Score (mean + SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.31 + 3.04</td>
<td>21.35 + 2.08</td>
<td>23.61 + 2.42</td>
<td>26.69 + 2.55</td>
<td>95.96 + 6.36</td>
<td></td>
</tr>
<tr>
<td>Self-rated English Evaluation (n (%))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very poor</td>
<td>2(2.2)</td>
<td>2(2.2)</td>
<td>1(1.1)</td>
<td>2(2.2)</td>
<td>2(2.2)</td>
</tr>
<tr>
<td>Poor</td>
<td>6(6.5)</td>
<td>14(15.1)</td>
<td>17(18.3)</td>
<td>7(7.5)</td>
<td>9(9.7)</td>
</tr>
<tr>
<td>Average</td>
<td>64(68.8)</td>
<td>64(68.8)</td>
<td>63(67.7)</td>
<td>48(51.6)</td>
<td>68(73.1)</td>
</tr>
<tr>
<td>Good</td>
<td>20(21.5)</td>
<td>12(12.9)</td>
<td>10(10.8)</td>
<td>33(35.5)</td>
<td>13(14.0)</td>
</tr>
<tr>
<td>Very good</td>
<td>1(1.1)</td>
<td>1(1.1)</td>
<td>2(2.2)</td>
<td>3(3.2)</td>
<td>1(1.1)</td>
</tr>
</tbody>
</table>

Table 3-3. Changes in dietary patterns of Chinese students (n=85) between time residing in China and in the United States (Mean + SE)

<table>
<thead>
<tr>
<th>Variables</th>
<th>In China</th>
<th>In U.S.</th>
<th>Difference</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber (g/day)</td>
<td>17.7 ± 0.30</td>
<td>15.8 ± 0.26</td>
<td>-1.9 ± 0.31</td>
<td>0.000***</td>
</tr>
<tr>
<td>Whole Grain (oz/day)</td>
<td>0.7 ± 0.03</td>
<td>0.6 ± 0.02</td>
<td>-0.1 ± 0.03</td>
<td>0.012*</td>
</tr>
<tr>
<td>All Fruit &amp; Vegetables (cup/day) 1</td>
<td>3.2 ± 0.08</td>
<td>2.7 ± 0.07</td>
<td>-0.5 ± 0.08</td>
<td>0.000***</td>
</tr>
<tr>
<td>Healthy Fruit &amp; Vegetables (cup/day) 2</td>
<td>3.1 ± 0.08</td>
<td>2.6 ± 0.07</td>
<td>-0.5 ± 0.09</td>
<td>0.000***</td>
</tr>
<tr>
<td>All Vegetables (cup/day) 3</td>
<td>2.1 ± 0.05</td>
<td>1.7 ± 0.04</td>
<td>-0.4 ± 0.05</td>
<td>0.000***</td>
</tr>
<tr>
<td>Healthy Vegetables (cup/day) 4</td>
<td>2.0 ± 0.05</td>
<td>1.6 ± 0.04</td>
<td>-0.4 ± 0.05</td>
<td>0.000***</td>
</tr>
<tr>
<td>Fruit (cup/day)</td>
<td>1.0 ± 0.04</td>
<td>1.0 ± 0.04</td>
<td>0.0 ± 0.05</td>
<td>0.246</td>
</tr>
<tr>
<td>Sugar (tsp/day)</td>
<td>14.2 ± 0.34</td>
<td>15.8 ± 0.46</td>
<td>1.6 ± 0.41</td>
<td>0.000***</td>
</tr>
<tr>
<td>SSB (tsp/day) 5</td>
<td>6.2 ± 0.24</td>
<td>7.0 ± 0.30</td>
<td>0.8 ± 0.27</td>
<td>0.008**</td>
</tr>
<tr>
<td>Dairy (cup/day)</td>
<td>1.5 ± 0.05</td>
<td>1.7 ± 0.05</td>
<td>0.2 ± 0.05</td>
<td>0.000***</td>
</tr>
<tr>
<td>Calcium (mg/day)</td>
<td>945.5 ± 15.92</td>
<td>1004.6 ± 18.22</td>
<td>59.1 ± 18.08</td>
<td>0.002**</td>
</tr>
</tbody>
</table>

1. Fruit and vegetables including legumes and French fries
2. Fruit and vegetables including legumes and excluding French fries
3. Vegetables including legumes and French fries
4. Vegetables including legumes and excluding French fries
5. Added sugars from sugar-sweetened beverages

* P<0.05, ** P<0.01, *** P<0.001 significantly different by Paired T-test.
Table 3-4. The changes in eating behaviors of Chinese students (n=93) between time residing in China and in the United States

<table>
<thead>
<tr>
<th>Variables</th>
<th>In China n (%)</th>
<th>In U.S. n (%)</th>
<th>n (%) who changed behaviors</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency of eating takeaway foods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>11 (11.8)</td>
<td>42(45.2)</td>
<td>decrease</td>
<td>51 (54.8)</td>
</tr>
<tr>
<td>&lt; 1 meal/week</td>
<td>28(30.1)</td>
<td>20(21.5)</td>
<td>same</td>
<td>22 (23.7)</td>
</tr>
<tr>
<td>About 1 meal/week</td>
<td>27(29.0)</td>
<td>11(11.8)</td>
<td>increase</td>
<td>20 (21.5)</td>
</tr>
<tr>
<td>&gt;= 2 meals/week</td>
<td>27(29.0)</td>
<td>20(21.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of eating convenience foods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>26(28.0)</td>
<td>14(15.1)</td>
<td>decrease</td>
<td>13 (14.0)</td>
</tr>
<tr>
<td>&lt; 1 meal/week</td>
<td>37(39.8)</td>
<td>23(24.7)</td>
<td>same</td>
<td>30 (32.3)</td>
</tr>
<tr>
<td>About 1 meal/week</td>
<td>17(18.3)</td>
<td>19(20.4)</td>
<td>increase</td>
<td>50 (53.8)</td>
</tr>
<tr>
<td>&gt;= 2 meals/week</td>
<td>13(14.0)</td>
<td>37(39.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of eating outside</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>1(1.1)</td>
<td>5(5.4)</td>
<td>decrease</td>
<td>30 (32.3)</td>
</tr>
<tr>
<td>&lt; 1 meal/week</td>
<td>25(26.9)</td>
<td>33(35.5)</td>
<td>same</td>
<td>46 (49.5)</td>
</tr>
<tr>
<td>About 1 meal/week</td>
<td>33(35.5)</td>
<td>24(25.8)</td>
<td>increase</td>
<td>17 (18.3)</td>
</tr>
<tr>
<td>&gt;= 2 meals/week</td>
<td>34(36.6)</td>
<td>31(33.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of eating breakfast</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/seldom</td>
<td>23(24.7)</td>
<td>28(30.1)</td>
<td>decrease</td>
<td>21 (22.6)</td>
</tr>
<tr>
<td>Often</td>
<td>24(25.8)</td>
<td>24(25.8)</td>
<td>same</td>
<td>55 (59.1)</td>
</tr>
<tr>
<td>Always</td>
<td>46(49.5)</td>
<td>41(44.1)</td>
<td>increase</td>
<td>17 (18.3)</td>
</tr>
<tr>
<td><strong>Number of meals/day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;= 2 meals/day</td>
<td>27(29.0)</td>
<td>31(33.3)</td>
<td>decrease</td>
<td>16 (17.2)</td>
</tr>
<tr>
<td>3 meals/day</td>
<td>64(68.8)</td>
<td>60(64.5)</td>
<td>same</td>
<td>65 (69.9)</td>
</tr>
<tr>
<td>&gt;= 4 meals/day</td>
<td>2(2.2)</td>
<td>2(2.2)</td>
<td>increase</td>
<td>12 (12.9)</td>
</tr>
<tr>
<td><strong>Shopping foods</strong> a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30(32.3)</td>
<td>86(92.5)</td>
<td>yes-no</td>
<td>3 (3.2)</td>
</tr>
<tr>
<td>No</td>
<td>63(67.7)</td>
<td>7(7.5)</td>
<td>same</td>
<td>31 (33.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>no-yes</td>
<td>59 (63.4)</td>
</tr>
<tr>
<td><strong>Frequency of cooking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td>59(63.4)</td>
<td>6(6.5)</td>
<td>decrease</td>
<td>9 (9.7)</td>
</tr>
<tr>
<td>1 time/week</td>
<td>8(8.6)</td>
<td>5(5.4)</td>
<td>same</td>
<td>17 (18.3)</td>
</tr>
<tr>
<td>3 times/week</td>
<td>12(12.9)</td>
<td>35(37.6)</td>
<td>increase</td>
<td>67 (72.1)</td>
</tr>
<tr>
<td>Daily</td>
<td>14(15.1)</td>
<td>47(50.5)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a: Variable of shopping foods is analyzed by Chi-square Test and other variables by Wilcoxon Signed Ranks Test.
b: Pearson Chi-square value
*** P<0.001 significantly different by Wilcoxon Signed Ranks Test or Chi-square Test.
Table 3-5. The changes in physical activity (MET-minutes/week) by domain and intensities of Chinese students (n=87) between time residing in China and in the United States (Mean ± SE)

<table>
<thead>
<tr>
<th>Variables</th>
<th>In China</th>
<th>In U.S.</th>
<th>Difference (In U.S. - In China)</th>
<th>P-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>1270 ± 199&lt;sup&gt;a&lt;/sup&gt;</td>
<td>399 ± 69&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>-871 ± 206</td>
<td>0.000***</td>
</tr>
<tr>
<td>Transportation</td>
<td>1000 ± 119&lt;sup&gt;a&lt;/sup&gt;</td>
<td>246 ± 34&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-754 ± 120</td>
<td>0.000***</td>
</tr>
<tr>
<td>Garden</td>
<td>157 ± 26</td>
<td>153 ± 25&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-4 ± 35</td>
<td>0.899</td>
</tr>
<tr>
<td>Leisure</td>
<td>1516 ± 161&lt;sup&gt;a&lt;/sup&gt;</td>
<td>668 ± 88&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-848 ± 153</td>
<td>0.000***</td>
</tr>
<tr>
<td><strong>Intensities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>1908 ± 211</td>
<td>534 ± 74</td>
<td>-1374 ± 209</td>
<td>0.000***</td>
</tr>
<tr>
<td>Moderation</td>
<td>1002 ± 118&lt;sup&gt;b&lt;/sup&gt;</td>
<td>420 ± 55</td>
<td>-582 ± 122</td>
<td>0.000***</td>
</tr>
<tr>
<td>Vigorous</td>
<td>1033 ± 141&lt;sup&gt;b&lt;/sup&gt;</td>
<td>511 ± 74</td>
<td>-522 ± 121</td>
<td>0.000***</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3942 ± 300</td>
<td>1465 ± 136</td>
<td>-2477 ± 291</td>
<td>0.000***</td>
</tr>
</tbody>
</table>

*** P<0.001 significantly different by Paired T Test.

<sup>a</sup>: significantly different from garden in China (ANOVA followed by Turkey post hoc testing)
<sup>b</sup>: significantly different from walking in China (ANOVA followed by Turkey post hoc testing)
<sup>c</sup>: significantly different from garden in U.S. (ANOVA followed by Turkey post hoc testing)
<sup>d</sup>: significantly different from leisure in U.S. (ANOVA followed by Turkey post hoc testing)

---

Table 3-6. The changes in sleeping duration of Chinese students (n=93) between time residing in China and in the United States

<table>
<thead>
<tr>
<th>Variables</th>
<th>In China n(%)</th>
<th>In U.S. n(%)</th>
<th>n (%) who changed behaviors</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤6 hours/day</td>
<td>10(10.8)</td>
<td>14(15.1)</td>
<td>decrease</td>
<td>37 (39.8)</td>
</tr>
<tr>
<td>7 hours/day</td>
<td>43(46.2)</td>
<td>54(58.1)</td>
<td>same</td>
<td>40 (43.0)</td>
</tr>
<tr>
<td>8 hours/day</td>
<td>34(36.6)</td>
<td>22(23.7)</td>
<td>increase</td>
<td>16 (17.2)</td>
</tr>
<tr>
<td>≥9 hours/day</td>
<td>6(6.5)</td>
<td>3(3.2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P<0.05 significantly different by Wilcoxon Signed Ranks Test.

---

Table 3-7. The changes in weight of Chinese students between time residing in China and in the United States (Mean ± SE)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Body Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In China</td>
<td>In U.S.</td>
</tr>
<tr>
<td>Male (n=55)</td>
<td>69.2 ± 1.48</td>
</tr>
<tr>
<td>Female (n=38)</td>
<td>53.2 ± 1.00</td>
</tr>
<tr>
<td>Total (n=93)</td>
<td>62.7 ± 1.28</td>
</tr>
</tbody>
</table>

** P<0.01 significantly different by Paired T Test.
Table 3-8. The correlation of demographic characteristics with mean intake of food groups in US.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fiber</th>
<th>Whole grain</th>
<th>FVL</th>
<th>FVLNF</th>
<th>VLALL</th>
<th>VLNF</th>
<th>Fruit</th>
<th>Sugar</th>
<th>SSB</th>
<th>Dairy</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.038</td>
<td>-0.029</td>
<td>0.063</td>
<td>0.08</td>
<td>0.037</td>
<td>0.043</td>
<td>0.049</td>
<td>0.072</td>
<td>-0.02</td>
<td>-0.165</td>
<td>-0.065</td>
</tr>
<tr>
<td>Gender (43.5% female)</td>
<td>-0.586**</td>
<td>-0.054</td>
<td>-0.478**</td>
<td>-0.471**</td>
<td>-0.583**</td>
<td>-0.525**</td>
<td>-0.264*</td>
<td>-0.386**</td>
<td>-0.457**</td>
<td>-0.298**</td>
<td>-0.609**</td>
</tr>
<tr>
<td>TOFEL</td>
<td>-0.059</td>
<td>-0.011</td>
<td>-0.044</td>
<td>-0.033</td>
<td>-0.109</td>
<td>-0.091</td>
<td>0.057</td>
<td>-0.086</td>
<td>-0.109</td>
<td>0.142</td>
<td>0.023</td>
</tr>
<tr>
<td>Education (17.6% undergraduate)</td>
<td>-0.176</td>
<td>-0.004</td>
<td>-0.151</td>
<td>-0.143</td>
<td>-0.149</td>
<td>-0.141</td>
<td>-0.159</td>
<td>0.096</td>
<td>0.077</td>
<td>-0.111</td>
<td>-0.172</td>
</tr>
<tr>
<td>Relationship (40.0% not single)</td>
<td>0.031</td>
<td>-0.06</td>
<td>0.086</td>
<td>0.103</td>
<td>0.111</td>
<td>0.097</td>
<td>0.038</td>
<td>0.021</td>
<td>0.123</td>
<td>-0.151</td>
<td>-0.089</td>
</tr>
<tr>
<td>Location (78.8% off campus)</td>
<td>0.195</td>
<td>0.14</td>
<td>0.152</td>
<td>0.135</td>
<td>0.135</td>
<td>0.14</td>
<td>0.115</td>
<td>0.084</td>
<td>-0.049</td>
<td>-0.056</td>
<td>0.004</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (7.1%)</td>
<td>-0.202</td>
<td>-0.038</td>
<td>-0.222*</td>
<td>-0.197</td>
<td>-0.171</td>
<td>-0.163</td>
<td>-0.249*</td>
<td>-0.123</td>
<td>-0.007</td>
<td>0.09</td>
<td>-0.003</td>
</tr>
<tr>
<td>Average (76.5)</td>
<td>0.097</td>
<td>-0.053</td>
<td>0.149</td>
<td>0.132</td>
<td>0.102</td>
<td>0.089</td>
<td>0.205</td>
<td>0.083</td>
<td>0.042</td>
<td>-0.064</td>
<td>0.001</td>
</tr>
<tr>
<td>High (16.5%)</td>
<td>-0.156</td>
<td>-0.162</td>
<td>-0.036</td>
<td>-0.044</td>
<td>-0.098</td>
<td>-0.089</td>
<td>0.016</td>
<td>-0.178</td>
<td>-0.185</td>
<td>0.142</td>
<td>0.027</td>
</tr>
<tr>
<td>Self-rated English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very poor (1.2%)</td>
<td>0.023</td>
<td>-0.08</td>
<td>0.046</td>
<td>0.057</td>
<td>-0.005</td>
<td>-0.021</td>
<td>0.065</td>
<td>-0.066</td>
<td>-0.016</td>
<td>-0.076</td>
<td>-0.039</td>
</tr>
<tr>
<td>Poor (9.4%)</td>
<td>0</td>
<td>-0.008</td>
<td>-0.058</td>
<td>-0.055</td>
<td>0.021</td>
<td>0.027</td>
<td>-0.067</td>
<td>0.077</td>
<td>0.058</td>
<td>0.027</td>
<td>0.099</td>
</tr>
<tr>
<td>Average (72.9%)</td>
<td>0.047</td>
<td>0.077</td>
<td>0.083</td>
<td>0.081</td>
<td>0.051</td>
<td>0.052</td>
<td>0.071</td>
<td>0.056</td>
<td>0.022</td>
<td>0.01</td>
<td>-0.063</td>
</tr>
<tr>
<td>Good (15.3%)</td>
<td>-0.062</td>
<td>0.156</td>
<td>-0.125</td>
<td>-0.156</td>
<td>-0.142</td>
<td>-0.138</td>
<td>-0.151</td>
<td>-0.147</td>
<td>-0.084</td>
<td>-0.082</td>
<td>-0.12</td>
</tr>
<tr>
<td>very good (1.2%)</td>
<td>-0.101</td>
<td>0.077</td>
<td>-0.153</td>
<td>-0.176</td>
<td>-0.143</td>
<td>-0.153</td>
<td>-0.073</td>
<td>-0.031</td>
<td>-0.106</td>
<td>-0.026</td>
<td>-0.031</td>
</tr>
<tr>
<td>Food safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often not enough to eat (1.2%)</td>
<td>0.057</td>
<td>0.19</td>
<td>-0.003</td>
<td>-0.033</td>
<td>0.047</td>
<td>0.04</td>
<td>-0.084</td>
<td>0.007</td>
<td>-0.144</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>Sometimes not enough (2.4%)</td>
<td>-0.139</td>
<td>-0.270*</td>
<td>-0.065</td>
<td>-0.049</td>
<td>-0.117</td>
<td>-0.117</td>
<td>-0.043</td>
<td>-0.105</td>
<td>0.081</td>
<td>-0.291**</td>
<td>-0.255*</td>
</tr>
<tr>
<td>Enough but not always (77.6%)</td>
<td>0.157</td>
<td>0.189</td>
<td>0.118</td>
<td>0.121</td>
<td>0.15</td>
<td>0.156</td>
<td>0.104</td>
<td>0.121</td>
<td>0.005</td>
<td>-0.276*</td>
<td>-0.248*</td>
</tr>
</tbody>
</table>

* correlation is significant at the 0.05 level
** correlation is significant at the 0.01 level
### Table 3-9. Correlation of predictor variables and average consumption of food groups in US.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fiber</th>
<th>Whole grain</th>
<th>FVL</th>
<th>FVLNF</th>
<th>VLALL</th>
<th>VLNF</th>
<th>Fruit</th>
<th>Sugar</th>
<th>SSB</th>
<th>Dairy</th>
<th>Calciu m</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIA-Heritage</td>
<td>0.014</td>
<td>0.16</td>
<td>0.026</td>
<td>0.049</td>
<td>0.174</td>
<td>0.161</td>
<td>0.011</td>
<td>0.162</td>
<td>0.126</td>
<td>-0.154</td>
<td>-0.099</td>
</tr>
<tr>
<td>VIA-America</td>
<td>0.228*</td>
<td>0.229*</td>
<td>0.235*</td>
<td>0.235*</td>
<td>0.255*</td>
<td>0.249*</td>
<td>0.226*</td>
<td>0.19</td>
<td>0.104</td>
<td>-0.053</td>
<td>0.027</td>
</tr>
<tr>
<td>VIA-Integration</td>
<td>0.147</td>
<td>0.199</td>
<td>0.168</td>
<td>0.181</td>
<td>0.26*</td>
<td>0.247*</td>
<td>0.168</td>
<td>0.229*</td>
<td>0.155</td>
<td>-0.075</td>
<td>0</td>
</tr>
<tr>
<td>Acculturative Stress</td>
<td>-0.077</td>
<td>-0.039</td>
<td>-0.095</td>
<td>-0.087</td>
<td>-0.147</td>
<td>-0.159</td>
<td>0.023</td>
<td>0.035</td>
<td>-0.004</td>
<td>-0.11</td>
<td>-0.076</td>
</tr>
</tbody>
</table>

* P <0.05 significant correlated by Partial Correlation, controlling for gender.

### Table 3-10. Correlations of predictor variables with eating behaviors and sleep duration in US.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Takeout foods</th>
<th>Convenience foods</th>
<th>Eating outside</th>
<th>Breakfast</th>
<th>Meals/day</th>
<th>Shopping foods</th>
<th>Cooking at home</th>
<th>Sleep duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIA-Heritage</td>
<td>0.166</td>
<td>0.085</td>
<td>0.19</td>
<td>0.122</td>
<td>0.092</td>
<td>0.053</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td>VIA-America</td>
<td>0.01</td>
<td>-0.15</td>
<td>0.009</td>
<td>0.182</td>
<td>0.116</td>
<td>-0.124</td>
<td>0.019</td>
<td>0.07</td>
</tr>
<tr>
<td>VIA-Integration</td>
<td>0.079</td>
<td>-0.012</td>
<td>0.144</td>
<td>0.134</td>
<td>0.112</td>
<td>0.004</td>
<td>0.052</td>
<td>0.031</td>
</tr>
<tr>
<td>Acculturative Stress</td>
<td>0.246*</td>
<td>0.02</td>
<td>0.056</td>
<td>-0.231*</td>
<td>-0.225*</td>
<td>0.041</td>
<td>-0.041</td>
<td>0.035</td>
</tr>
</tbody>
</table>

* P<0.05, ** P<0.01, *** P<0.001 significantly correlated by Spearman Correlation.

### Table 3-11. Correlations of predictor variables and physical activity in US.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Walk</th>
<th>Moderation</th>
<th>Vigorous</th>
<th>Work</th>
<th>Transportation</th>
<th>Garden</th>
<th>Leisure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIA-Heritage</td>
<td>0.006</td>
<td>-0.069</td>
<td>0.067</td>
<td>0.006</td>
<td>-0.272*</td>
<td>0.098</td>
<td>-0.022</td>
<td>-0.061</td>
</tr>
<tr>
<td>VIA-America</td>
<td>0.237*</td>
<td>0.079</td>
<td>0.028</td>
<td>0.277**</td>
<td>0.034</td>
<td>0.12</td>
<td>0.007</td>
<td>0.176</td>
</tr>
<tr>
<td>VIA-Integration</td>
<td>0.13</td>
<td>-0.02</td>
<td>-0.043</td>
<td>0.102</td>
<td>0.133</td>
<td>0.129</td>
<td>-0.006</td>
<td>0.039</td>
</tr>
<tr>
<td>Acculturative Stress</td>
<td>0.053</td>
<td>-0.106</td>
<td>-0.015</td>
<td>0.068</td>
<td>-0.106</td>
<td>-0.177</td>
<td>0.005</td>
<td>-0.022</td>
</tr>
</tbody>
</table>

* P<0.05, ** P<0.01 significantly correlated by Pearson Correlation.

### Table 3-12. Correlations of predictor variables and body weight in US.

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIA-Heritage</td>
<td>-0.121</td>
<td>0.065</td>
<td>-0.038</td>
</tr>
<tr>
<td>VIA-America</td>
<td>-0.003</td>
<td>-0.113</td>
<td>-0.087</td>
</tr>
<tr>
<td>VIA-Integration</td>
<td>-0.061</td>
<td>-0.062</td>
<td>-0.078</td>
</tr>
<tr>
<td>Acculturative Stress</td>
<td>-0.223</td>
<td>-0.25</td>
<td>-0.101</td>
</tr>
</tbody>
</table>

Correlation was done by Pearson Correlation
Table 3-13. A hierarchical multiple regression analysis predicting changes in food groups from acculturative stress, acculturation and their interactions

<table>
<thead>
<tr>
<th>Variable</th>
<th>R square</th>
<th>R square change</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>acculturative stress</td>
<td>0.069</td>
<td>0.069</td>
<td>-0.249</td>
<td>0.308</td>
<td>-0.086</td>
</tr>
<tr>
<td>VIA-Amercia</td>
<td>0.715</td>
<td>0.308</td>
<td>0.247*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>0.11</td>
<td>0.041</td>
<td>-0.474</td>
<td>0.245</td>
<td>-0.212</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole Grain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>acculturative stress</td>
<td>0.019</td>
<td>0.019</td>
<td>-0.012</td>
<td>0.03</td>
<td>-0.043</td>
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<tr>
<td>VIA-Amercia</td>
<td>0.036</td>
<td>0.03</td>
<td>0.132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>step2</td>
<td>0.069</td>
<td>0.05*</td>
<td>-0.049</td>
<td>0.024</td>
<td>-0.234*</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FVL</td>
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<td></td>
<td></td>
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<tr>
<td>acculturative stress</td>
<td>0.117**</td>
<td>0.117**</td>
<td>-0.146</td>
<td>0.08</td>
<td>-0.289</td>
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<tr>
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<td>0.08</td>
<td>0.283**</td>
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<tr>
<td>Step 2</td>
<td>0.138</td>
<td>0.021</td>
<td>-0.091</td>
<td>0.065</td>
<td>-0.152</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLALL</td>
<td></td>
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<td>acculturative stress</td>
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<td>0.094*</td>
<td>-0.096</td>
<td>0.046</td>
<td>-0.218*</td>
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<td>0.094</td>
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<td>0.213*</td>
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<tr>
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<td>0.038</td>
<td>-0.069</td>
<td>0.037</td>
<td>-0.203</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>FVLNF</td>
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<td></td>
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<td>0.117**</td>
<td>-0.149</td>
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<td>0.021</td>
<td>-0.092</td>
<td>0.065</td>
<td>-0.151</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
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<td></td>
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<td>VLNF</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>acculturative stress</td>
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<td>0.097*</td>
<td>-0.108</td>
<td>0.049</td>
<td>-0.229*</td>
</tr>
<tr>
<td>VIA-Amercia</td>
<td>0.098</td>
<td>0.049</td>
<td>0.208(0.051)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
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<td>0.0037</td>
<td>-0.073</td>
<td>0.039</td>
<td>-0.202</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Variable</td>
<td>R square</td>
<td>R square change</td>
<td>B</td>
<td>SEB</td>
<td>β</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------------</td>
<td>-------</td>
<td>------</td>
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<tr>
<td>Fruit</td>
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</tr>
<tr>
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<td>0.125</td>
<td>-0.025</td>
<td>0.043</td>
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<tr>
<td>acculturative stress</td>
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<tr>
<td>VIA-America</td>
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<td>0.043</td>
<td>0.348***</td>
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<tr>
<td>Step 2</td>
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<td>0.007</td>
<td>-0.029</td>
<td>0.035</td>
<td>-0.089</td>
</tr>
<tr>
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<td></td>
<td></td>
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<tr>
<td>Sugar</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>0.068</td>
<td>0.091</td>
<td>0.399</td>
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<td>VIA-America</td>
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<td>0.399</td>
<td>0.260*</td>
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<td>0.000</td>
<td>-0.066</td>
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<td>-0.203</td>
</tr>
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<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SSB</td>
<td></td>
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</tr>
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<td>0.270</td>
<td>0.172</td>
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</tr>
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<td>Step 2</td>
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<td>0.000</td>
<td>-0.034</td>
<td>0.220</td>
<td>-0.018</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td></td>
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</tr>
<tr>
<td>Step 1</td>
<td>0.007</td>
<td>0.007</td>
<td>-0.042</td>
<td>0.055</td>
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</tr>
<tr>
<td>acculturative stress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIA-America</td>
<td>-0.001</td>
<td>0.055</td>
<td>-0.002</td>
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</tr>
<tr>
<td>Step 2</td>
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<td>-0.027</td>
<td>0.045</td>
<td>-0.069</td>
</tr>
<tr>
<td>Acculturative stress * VIA- America</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Calcium</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td>0.004</td>
<td>0.004</td>
<td>-9.896</td>
<td>18.375</td>
<td>-0.059</td>
</tr>
<tr>
<td>acculturative stress</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIA-America</td>
<td>2.261</td>
<td>18.375</td>
<td>0.014</td>
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<td></td>
</tr>
<tr>
<td>Step 2</td>
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<td>0.012</td>
<td>-14.833</td>
<td>14.840</td>
<td>-0.115</td>
</tr>
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<td>Acculturative stress * VIA- America</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
Figure 3-1. The relationship between acculturation and the change of whole grain intake from China to US by acculturative stress (p=0.04)

Figure 3-2. The relationship between acculturation and the change of fiber intake from China to US by acculturative stress (with no significant p-value)
Figure 3-3. The relationship between acculturation and the change of all vegetables intake from China to US by acculturative stress (with no significant p-value)

Figure 3-4. The relationship between acculturation and the change of healthy vegetables intake from China to US by acculturative stress (with no significant p-value)
CHAPTER 4
DISCUSSION

This study sought to examine changes in health behaviors of Chinese students sojourning to the US to pursue higher education. The results suggest that Chinese international students practiced unhealthier eating behaviors and dietary intake, as well as had less physical activity and sleeping time after moving to the US. We found that there was a significant decrease in dietary fiber, whole grains and vegetable intake, and a significant increase of sugar, sugar-sweetened beverages (SSB), dairy and calcium consumption when compared to reported intake in China. Study participants also decreased the frequency of eating takeout foods, but consumed convenience foods more frequently.

Moreover, the impact of acculturation and acculturative stress on these health behaviors is complex. Acculturation was significantly associated with dietary pattern and some aspects of physical activity, while acculturative stress was highly related to eating behaviors. Specifically, students who indicated a higher acculturation score consumed more fiber, whole grain, fruit and vegetables. While those with higher acculturative stress reported an increased consumption of takeout foods and skipped breakfast more frequently in the US compared with those reporting lower acculturative stress.

Change Dietary Patterns after Moving to the US

The consumption of all healthy foods except fruit decreased while sugar, SSB, dairy products and calcium intake increased after international students coming to the US. Results are consistent with Pan’s study which reported a significant increase of dairy products, sweets and a significant decrease in vegetables, however, our result contrast to the increased intake of fruit found by Pan and colleague (41). Another study
found Chinese Americans in Pennsylvania increased consumption of grains, vegetables, fruits, meat/meat alternatives, dairy products, fat/s sweets, and beverages, which conflicts with our results in terms of grains, vegetables and fruits intake (44). However, the participants in Lv’s study were Chinese American who were citizens of the United States or were applying for a green card, living in Pennsylvania; it is believed that sojourners (international students) had different acculturation experience from immigrants. Another explanation is the 12-years gap from Lv’s study, which may change the eating habits among Chinese. One explanation is that foods are more accessible and available in Pennsylvania than in a small college town-Gainesville, which cause the difference of healthy foods intake between two studies’ participants.

When comparing consumption patterns of major food groups between two countries, the Chinese Academy of Agricultural Sciences used data from Food and Agriculture Organization of the United Nations (FAO) in 2005-2007 period, finding that Chinese consumed more cereals and about 400 more grams of vegetables per person per day than America did. In contrast, Chinese consumed less sugar and sweeteners, less fruits as well as much less milk (excluding butter) than America (84). The consumption of dairy product was commonly mentioned when comparing the difference in food patterns between China and Western courtiers. National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention unofficially stated that Chinese residents consumed only about 400 mg of calcium per day and 90% have a severe deficiency in calcium intake in the Xinhua News 2013. He (85) reported that less than 5% of Chinese residents’ calcium intake reaches the requirement of Adequate Intake (AI). And only 4.3% of calcium came from dairy products. However, the mean
intake of calcium for the US population was 1029 mg per day in 2009 according to What We Eat in America NHANES 2009-2010, and 42% of them did not meet the Estimated Average Requirement (EAR) for calcium. Milk and dairy products contributed to 37% of calcium intake which was much higher than in China (86). One study evaluated dietary nutrients between China and the United States from 2010-2012. Data of Chinese population was collected by consecutive 24-h dietary recalls, and data of American diet was from NHANES 2009-2010 CDC. The results found that Chinese aged 20-29 consumed 416 mg/day of calcium, while American at that age consumed 1189 mg/day (87). One explanation of the increased trend of calcium and dairy consumption is that diary products are more accessible and less expensive in the US than China (44). In our study, we found there was a significant decrease in the consumption of fiber, whole grain, fruit and vegetables group (FVALL and FVNF), vegetables (VALL and VANF), with a significant increase in sugar, SSB, dairy and calcium intake of Chinese international students between residing in China and in United States. This could be explained by the Westernization of dietary pattern after coming to the US. Another reason why they decreased consumption of such healthy foods may be the availability. Most international students reported in another study that the foods provided in US was much different from their traditional foods, and they did not like such foods (88). What’s more, cost was an important reason contributing to the change of eating pattern (89). Perez-Cueto et al. explained that limited budget of international students led them eat less fruits and vegetables which were perceived as rather expensive than in home country (90).
We compared our data of daily intake with that of US population. The source of US daily intake is from NHANES 2007-2010 (average daily intake of food source and demographic characteristics). We found that average daily intake of fruit is 1.05 cups of US population, which was similar as fruit intake in China of Chinese students; it is consistent with our results of no difference in fruit intake after coming to the US. The daily vegetable intake was 1.42 cup of US population and was 2.09 cup of our participants; it may be the reason why they decreased the vegetable intake to 1.69 cup/day which was closer to 1.42 cup/day. Similarly, the daily dairy intake was 1.77 cup of US population and was 1.46 cup of our participants, which explained the increase trend of dairy consumption to 1.71 cup/day after coming to US. However, it is confused about whole grain intake. Chinese students consumed less whole grain in China compared with US population, but they still decreased the consumption after coming to the US. It may be because of the difference of whole grain resource - Chinese and Americans consume whole grains from different types of foods. Grain-based diet, such as wheat, millet, black rice, buckwheat, barley, is considered as traditional Chinese medicine nutrition. However, these items are not common in the US, leading to the decreased trend of whole grain consumption. As far as sugar intake is concerned, although our study showed that average consumption of sugar intake was increased to 15.76 tsp/day among Chinese international students, this number is still lower than mean daily intake of US population (17.73 tsp) among US population.

**The Change of Eating Behaviors and Sleep Time from Baseline**

The frequency of eating takeout foods decrease significantly after Chinese international students moving to the US. The major reason may be the convenience. In China, there are overwhelming apps providing 24-h delivery service. Wherever you are,
whenever you are hungry, even whatever you want to eat, you can always find a close restaurant with delivery service. However, in the United States, especially in a small city of US, there are a few food delivery service with few advertisements. The most popular type of food ordered for delivery is pizza, after pizza came sandwiches or burgers in United States, reported by Statista (91). The delivery service only provides narrow choices of delivery foods, which maybe not attracts Chinese students’ appetite. Another reason is the cost. In China, tipping is not a common phenomenon; therefore, Chinese students may not like to use delivery service due to relatively high delivery tip compared with their meal. Our study only found that students tend to eat outside less after coming to the United States. Cost may be the primary factor impacting eating habits. Besides, Epter mentioned in his dissertation that social factor is also an important factor leading people to eat outside the home. He mentioned that participants eat outside for celebrating important events, entertainment for participants, keeping in touch with friends (92). However, Chinese international students may not fully blend in the new environment within short period so that they do not have so many social activities which force them to eat outside. We also found there was an increase in the frequency of eating convenience foods and cooking at home, it may compensate for the decrease in eating takeout foods and eating outside, and correspondingly, the frequency of shopping foods increased. As we found, the frequency of eating breakfast did not change, which is not supported by other studies (44, 93). One study measured the change of dietary behavior among Chinese students in South Korea, and they found students were more likely to skipped meals (93). The different result may be the different culture of mainstream country: one is South Korea and one is United States.
The type of breakfast in United States is much simpler than that in Asia where the porridge, noodles and rice are main breakfast. So although Chinese students did not decrease breakfast intake, the type of breakfast may be changed to simpler breakfast foods, such as milk, bread and cereals as the Beiwei found in her study (89).

Our study found that Chinese students slept less after studying in the United States, which is consistent to previous study which reported that Chinese in China slept more than Chinese in North America by comparing two groups at the same time (94). One explanation for this result may be the difference of routine activity between two time points. The first questionnaire was done at the beginning of their first semester, asking about how much time they slept in China. Most students just had a long summer vacation before they came to the US. They did not have study burden or any other concerns during summer vacation which led them to sleep more. On the other hand, the second questionnaire was completed at the end of their first semester, a time when students may have spent a significant amount of time studying, leading to less sleep in US.

**The Change of Physical Activity from Baseline**

The previous studies showed that immigrants became more physically active after coming to the United States (Kandula & Lauderdale, 2005; Tremblay, Bryan, Perez, Ardern, & Katzmarzyk, 2006), and one of them had a somewhat similar group of immigrants - undergraduate international students (88). However, our study got the totally opposite result. There may be some reason to explain the contradiction. First, participants in the previous studies were not specific in Chinese students. The perception of physical activity among Chinese may be different from that among other ethnic groups. Zi Yan (95) examined how Chinese female graduate students perceived physical activity participation, such as facilitators and barriers they experienced, by
conducted a 1-on-1 semi-structured interviews for 20 participants. In the study, she found that the perceptions of femininity between Chinese female students and American students was different. In China, feminine means “graceful” instead of “athletic”, and thinness is one of the most important criteria identifying beauty and worth. Chinese culture traditionally favors “fair” skin tone instead of “tanned” skin tone, so that minimize outdoor physical activities to avoid being exposure by sunlight. Therefore, the traditional Chinese culture in terms of femininity may be the reason why our participants had a different trend of the change in physical activity from other studies’ participants. However, in Zi Yan’s study (95), it was also mentioned that Chinese female graduate students tended to change their perceptions and started to do some exercise to integrate into American culture. It may be because their participants had stayed in the United States about 36.5 months, which is much longer than our participants did. A 3-month period may be not enough for our participants to fully understand the American culture of physical activity and to change their traditional and deep-rooted Chinese culture. Another reason for the decreased trend may be the time point when we measured their physical activity. The second time point of the present study was between November 28th to December 30, 2016, including final exam period. Reviewing for the examinations may occupy their time which correspondingly may minimize their leisure time and the time for physical activity. The last reason is also one of the limitations of our study. We must acknowledge that the ways of answering question in the IPAQ were different between two time points. In the first questionnaire, asking the information when they lived in China, we used two blanks indicating hours and minutes respectively, to represent how long they take exercise per day. For example, if they
exercised for 90 minutes/day, they write 1 in the first blank and 30 in the second blank. However, some students were confused about two blanks and filled with 1.5 at first blank and 90 at second blank with only 90-minute exercise in the fact. To avoid such situation, in the second questionnaire, we only used one blank indicating minutes to represent the same situation. This method minimized the confusion for participants, however, it may have influenced the results to some extent. Because there may the situation that participant put 1 hour in the first questionnaire to estimate 50-minute physical activity, while put 50 minutes exactly in the second questionnaire, which subsequently, may be over-estimate the physical activity in the first questionnaire. This situation may exist in our study because we found the amount of physical activity went down dramatically from baseline. To ensure this was a true decrease and not based on the questions being asked differently, ANOVA and Post Hoc Test were used to confirm the expected relationship between various levels and various domains of physical activity at the single time point. For example, if there was difference among types of physical activity in China while no difference when they were in US, it indicates that their physical activity changed to some extent. In our study, we found that walk intensity was significantly different from moderation and vigorous intensity when students lived in China, while there was no difference when they lived in US. We also found the amount of moderate and vigorous physical activity in China were both about double than the amount in US, while the amount of walking physical activity in China was forth times than the amount in US. We could expect their physical activity changed after coming to the US, either decreased walk intensity or increase moderation and vigorous intensity. Another interpretation for this result is all intensities decreased after coming to the US,
while the walking-intensity decreased more than other two intensities. What’s more, in our previous statement, Chinese favors walking-intensity activity (49, 50, 96), which confirm again that our participants may decrease walking-intensity activity after coming to US or decreased more than other two intensities. As for physical activity in different domain, we found that leisure domain was significantly different from work, transportation and garden in US, but no different in China. And the amount of physical activity in the work domain and transportation domain in China were triple and quadruple times than that in US, respectively, while physical activity at leisure domain in China was only twice than that in US, which lead us to expect that physical activity at different domain changed after coming to the US, either increased physical activity at leisure domain or decreased physical activity at other domains, or all three domains decreased with the leisure domain decreasing less than other two. Previous studies showed that leisure-time physical activity level increased with the length of residing in the US increasing (Kendula & Lauderdale, 2005). Some Chinese female graduate students mentioned in Yi Zen’s study (Yi Zen, 2016) that different leisure opportunities are the facilitator for them to be more physically active. They mentioned leisure activities in China included shopping, karaoke and Chinese mahjong instead of physical activity, however, they did not have other leisure options after coming to the US, especially in the small college town, so that exercise at gym with friends became major leisure activity for them to socialize. Above studies may confirm our result that physical activity at leisure time may increase after coming to the US, or decreased less than other two domains. ANOVA and Post Hoc Test can only confirm that their physical activity changed to some extend from baseline, but cannot get the exact result about how they
changed. It is just an assistant tool to fix our limitation. The pilot study before the formal test is worthy to get better and valid result.

**The Change of Body Weight from Baseline**

Study showed that immigrants increased body weight as the time of residing in the US increased and immigrants started to increase body weight significantly only after 10 years of living in the US (18, 34). As for international students, Almohanna et al. (40) stated that they were more likely to gain weight within the first few months of arrival in the US. This study recruited 35 international students (from China, Indian, German, South African and South Korean) and examined the change of body weight between the beginning of their first semester and 12 weeks later. The time period was similar to our study. They found that students gained an average weight of 2.79 lb in; among them, female gained 4.0 lb which was significant, while male only gained 0.55 lb which was not significant. Consistently, 69% male and 85% female Chinese students in Wu’s study gained weight, with a 2.1 kg gain for males and 2.5 kg gain for females. In our study, we also found that females had a significantly weight gain and males not, however, our study did not find a significant increase for total participants. It may be because female is easier to store fat than men, so it is possible that they both eat high-fat diet, but only females begin to increase weight while males not yet within 3 months. Another potential explanation is that males are more physically active than females, which compensated the likelihood of contribution of unhealthier diet intake to weight gain. It was supported by the further analysis: study compared the amount of physical activity between males and females, and found significant difference (p=0.04 at time point 1 and p=0.01 time point 2) between gender.
Acculturation, Acculturative Stress and Dietary Pattern

VIA-American score was highly related to the consumption of fiber, whole grain, all fruit and vegetables group, healthy fruit and vegetables group, all vegetables, healthy vegetables, as well as fruit intake, after controlling gender. In other words, Chinese students who acculturate to American culture better have a healthier dietary pattern. Although our findings conflict with our expectation, they are consistent with the results of other study in terms of the relationship of acculturation and fruit/vegetable intake (Lv & Cason, 2004). As Satia-Abouta suggested, the higher healthy foods intake with higher acculturation to American culture could be explained by the accessibility of nutrient education in English (45, 97). Studies have demonstrated that nutritional knowledge is associated with healthful dietary change (98). Satia-Abouta also mentioned that Chinese students with higher acculturation were more likely to engage in different activities (97), including activity related to healthy lifestyle, such as Choose MyPlate at College or National 5 A Day. Yan also found that health education was one of factor driving international students to eat healthier. She mentioned some international students did not know the nutrition food label until they came to the US (88).

Acculturated Chinese students participated in the health-related events and subsequently strengthen their awareness of healthy lifestyle and expand their knowledge about nutrition, and finally eat more healthy foods subconsciously. Secondly, Satia-Abouta also explained that acculturated group may be more likely to accept “new” foods. It was supported by Beiwen’s study, which found that most students could not accept raw salad because traditional Chinese agricultural used human or livestock feces to fertilize vegetables (89). Acculturative Chinese students have more choices of fruits and vegetables when Chinese-like vegetables and fruits are limited in American
supermarket. However, some studies suggested that older Chinese who was acknowledge as low acculturative, consumed more vegetables in US (25, 99). Our cross-sectional study also found VIA-Integration score was positively associated with the consumption of all vegetables, healthy vegetables, as well as sugar of Chinese students studying in the US. In another word, bi-cultural Chinese students consumed more vegetables. Similar to the previous explanation, they could accept new things and retain their traditional food items, which allows them have more food choices. In summary, our study showed that higher acculturated group seems to have healthier dietary pattern than less acculturated group.

However, in our study, we did not find any significant relationship between acculturative stress and dietary pattern among Chinese international students studying in the US. There are two potential explanations. First, previous studies which identified the relationship of stress and emotional eating (62-65) considered general stress as their indicator. However, in our study, we only focused on stress related to acculturation. It is possible that acculturative stress is not related to intake of food groups while stress in general is. Second, measurement error may also exist, because it may be hard for some students to distinguish stress in general from stress in acculturation. Some academic questions in our acculturative stress scale may be also suitable to American students: I hesitate to participate in class discussion and seminar; I feel a lot of academic pressure; the intensive study makes me sick. To distinguish acculturative stress from academic stress which also involves in American students’ life, we already stated at the beginning of the questionnaire, writing with “please distinguish the acculturative stress from normal
academic stress”, but we cannot guarantee this statement could 100% avoid the confusion of acculturative stress and academic stress.

**Acculturative Stress and Eating Behaviors**

Our study found acculturative stress was associated with an increase in frequency of eating takeout foods and a decrease in frequency of breakfast and decreased daily meals consumption. It may be because Chinese students with higher acculturative stress had more academic pressure and poorer English, so they have to spend more time on studying than academic-successful Chinese students and American students, which minimizes their time on cooking or having a regular meal. Consequently, they eat more takeout foods and decreased the number of meals, especially breakfast. There was no relationship between acculturative stress and sleep duration, however, study did not involve sleep quality as one of interested outcomes, so it is not sure if sleep quality is disturbed under high acculturative stress. It may be because Chinese students with higher stress may experience a decrease in quality of sleep (71, 72, 74); they wake up tiredly and late, hurry to take class on the morning, and subsequently did not have time to eat breakfast. Our study did not find the significant relationship between acculturative stress and increased frequency of eating convenience foods, which conflicts to our expect and explanation. One of possible reasons may be that the frequency of eating convenience foods is already very high-over half of them consumed convenience foods greater or equal than 1 times/week (Table 3.4), so that acculturative stress cannot impact the frequency any more due to the high base level.
Acculturation and Physical Activity

Contrary to our expectation that VIA-Heritage score should be positively correlated to walking intensity due to Chinese traditional habit in terms of physical activity, our result showed higher VIA-America score was positively associated with walking intensity and physical activity at work domain. That is Chinese students who acculturated to American culture better actually walked more after coming to the US than students who are less acculturated. The increase in the walking intensity may be from the work domain since they had the similar coefficients correlated to VIA-America. The correlation coefficient of walking-intensity activity and work domain was 0.6 (p<0.001). One possible explanation is that Chinese international students are more acculturated if they have a research program in the lab or part-time job around campus; in that case, they have more opportunity walking around the lab or working place, compared with non-job or non-research Chinese students.

Moderation

In our study, we only found a significant interaction between acculturative stress and acculturation in terms of the change in whole grain consumption from baseline, meaning that acculturative stress is a statistically significant moderator of the linear relationship between acculturation and the change of whole grain intake from baseline. Figure 3.1 shows the predicted relationship at high and low levels of acculturative stress. It demonstrated that the relationship is apparent only at low acculturative stress. In other words, the role of acculturation diminishing the decrease trend in whole grain consumption only existed when Chinese students had low acculturative stress. Besides, Chinese students reporting high acculturative stress did not change their whole grain intake by acculturation. This result was contrast to our expectation which we thought the
relationship between acculturation and health behaviors was more pronounceable in high acculturative stress, since we assumed that acculturation was negatively associated with health behaviors. However, in our study, we actually found the positive role of acculturation in health behaviors, which was plausible when the positive relationship was more significant in low acculturative stress group. Similar results were found for the change in fiber, all vegetables, and healthy vegetables with p-values close to 0.50. In summary, as the result from aim 2 demonstrated, higher acculturation was associated with healthier dietary pattern; it only holds true, however, when Chinese students experienced low acculturative stress.

**Strengths, Limitations and Future Studies**

Our study involves different kinds of health behaviors, such as dietary pattern, dietary behaviors, physical activity and sleep duration, relating to acculturation and acculturative stress within same subjects. Participants in the study were Chinese new students who just came to the United States within the first month and have not lived outside of China for more than 3 months at any time in their life, so our participants are more likely to suffer from culture shock and more likely to have behaviors change due to culture shock. Our study is one of few studies conducting the relationship between stress and health behaviors, and the first one examines the moderation effect of acculturative stress on the relation of acculturation with health behaviors. Although this study only found one significant result in the moderation effect part, it is a new train of thinking to see how stress or acculturative stress plays a role in influencing behaviors during the process of acculturation.

There are also a number of limitations in the present study. First, our sample size (n=93) is modest and all samples were from a specific area in a Southeastern University
in the US, limiting the generalization of our findings. So future studies could focus on the sojourn experience of Chinese students on a broader population from different universities all around US. Secondly, 3-months period may be not enough to distinguish more acculturated Chinese students from less acculturated Chinese students, follow-up study is needed to show how the changes in health-behaviors are associated with the changes in acculturation and acculturative stress. Thirdly, further study could focus on the stress in general, combined with or without acculturative stress to see its relationship with the change of health behaviors, since acculturative stress measured was not a very broad sampling of all psychological predictors. It is possible that a larger aspect of psychological factors may enable us to find stronger association between acculturative stress and health behaviors, as well as stronger moderation effect on the relation of acculturation and health behaviors. Finally, our assessments are based on the self-reported questionnaires in which situation bias and social desirability may exist. For example, the average of their acculturative stress was 2.83 over 7, indicating low acculturative stress. However, social desirability makes them choose relatively lower points when answering the question. Further study could also conduct a focus group or semi-structured interviews to elicit Chinese students’ perspective and experiences with the concepts to the change in health behaviors related to acculturation and acculturative stress, which help us understand the underling mechanism of the change and the relationship, in addition to develop an intervention focusing on Chinese students’ health and fitness.
CHAPTER 5
IMPLICATIONS AND CONCLUSION

Implications

Although Chinese international students exhibited a decline in several health behaviors after coming to the United States, acculturation to the American culture blunted this effect. To support healthy acculturation, one solution would be to match Chinese students with American students as voluntary partners to foster integration into American culture. Under high acculturative stress, Chinese students are more likely to skip meals or eat takeout foods as we found in the study, which is a risk factor of health issues. And it is possible stress in general, rather than acculturative stress, drives Chinese students over-consume “palatable non-nutritional foods” to relieve their negative emotion. Thus, it is necessary for them to seek other healthier ways to relive their stress, therefore universities could be recruited psychologist to provide free psychological consultation. And teach them how to manage their emotion and stress and ways to relieve their negative emotion. Since there are many more fast restaurants around campus compared to family restaurants, teaching Chinese students how to choose restaurants where healthy foods are provided and how to choose foods to balance their diet when eating outside. What’s more, due to a lack of availability of Chinese kind of healthy foods, Chinese international students decreased the consumption of vegetables and fruits since they come to the US; therefore, universities could partner with local Chinese markets and farmer markets to provide fresh Chinese vegetables and fruits with lower price once a week.
Conclusion

This prospective, observational study examined changes in dietary pattern, dietary habits, physical activity, sleeping duration and body weight, and examined the role of acculturation and acculturative stress on such health-related behaviors and body weight of Chinese international students before and after sojourning to the United States. Chinese international students had less healthy eating behaviors and diet intake after moving to the United States, and that acculturation and acculturative stress impacted health behaviors in opposite ways. Findings from this study support the rationale for researchers and university administrators to provide supportive programs to reduce stress associated with acculturation and support healthy living for Chinese international students.
APPENDIX A
QUESTIONNAIRES

Demographics Questionnaire-Before

1. What is your age (in years)? *drop down

2. What is your sex?
   - Male
   - Female
   - Choose not to answer

3. Which country did you live in before moving to the United States?
   - China
   - Saudi Arabia
   - Kuwait
   - United Arab Emirates
   - Bahrain
   - Qatar
   - Oman
   - Other – comment box

4. Have you lived in this same country you selected in the previous question for 5 years or more?
   - Yes
   - No

5. If no, in which other country did you live?
   - Comment box
   - Choose not to answer

6. Are you currently an undergraduate, graduate student, or attending the English Language Institute (ELI) at University of Florida?
   - Undergraduate
   - Graduate
   - English Language Institute
   - Choose not to answer

7. What is your current major?
   - Agricultural Sciences
   - Biological Sciences
   - Business/Communication
   - Chemistry
   - Education
   - Engineering
   - Exercise Science/Kinesiology
   - Fine Arts/Humanities
   - Health/Nursing
   - Social Sciences
   - Undeclared
   - Other – comment box
   - Choose not to answer
8. How good are you at understanding spoken English?
   o 1 = Very Poor
   o 2 = Poor
   o 3 = Average
   o 4 = Good
   o 5 = Very Good (Fluent)

9. How would you rate your English conversation ability?
   o 1 = Very Poor
   o 2 = Poor
   o 3 = Average
   o 4 = Good
   o 5 = Very Good (Fluent)

10. How good are you in writing papers in English?
    o 1 = Very Poor
    o 2 = Poor
    o 3 = Average
    o 4 = Good
    o 5 = Very Good (Fluent)

11. How good are you in reading your English books or articles?
    o 1 = Very Poor
    o 2 = Poor
    o 3 = Average
    o 4 = Good
    o 5 = Very Good (Fluent)

12. Overall, how would you rate your English?
    o 1 = Very Poor
    o 2 = Poor
    o 3 = Average
    o 4 = Good
    o 5 = Very Good (Fluent)

13. How would you define your current relationship status?
    o Single
    o Married
    o In a committed relationship
    o Choose not to answer

14. How many children (if any) do you have?
    o 0
    o 1
    o 2
    o 3
    o 4 or more
    o Choose not to answer

15. What is your height?
    o ________cm

16. What is your current weight (in kilograms)?
    o ________kg
17. How would you describe the economic standing of your family compared with other families in your home country?
   - Lower than average income
   - About average income
   - Higher than average income

18. Which of the following statements best describes the food eaten in your household in the last 12 months:
   - Enough of the kinds of food we want to eat
   - Enough but not always the kinds of food we want
   - Sometimes not enough to eat
   - Often not enough to eat
   - Choose not to answer

19. How do you pay for your education at the University of Florida? Please select the choice that is paying for the majority of your education and living expenses.
   - My family
   - Myself
   - A scholarship from my home country or work place
   - A scholarship from the United States government or foundation
   - I will be supported by a research grant or University of Florida faculty

20. When you were in your home country, once you had fallen asleep, how long did you sleep for?
   - ≤ 6 hours
   - 7 hours
   - 8 hours
   - ≥ 9 hours

21. What's your TOEFL/IELTS score?
   - Listening: _________
   - Reading: ________
   - Writing: _________
   - Speaking:_________
   - Choose not to answer
Demographic Questionnaire - After

Please provide us with the following information about yourself.

1. Where do you live currently?
   o On campus
   o Off campus

2. How would you define your current relationship status?
   o Single – turn to question 4
   o Married
   o In a committed relationship, but not married – turn to question 4
   o Choose not to answer - turn to question 4

3. If you are married, does your spouse/significant other live with you?
   o Yes
   o No

4. If you are not married, or if your significant other/family does not live with you, how many roommates do you have currently?
   o 0
   o 1
   o 2
   o 3
   o 4 or more

5. Do you have relatives in Florida?
   o Yes
   o No

6. Which of the following statements best describes the food eaten in your home after you moved to the United States?
   o Enough of the kinds of food we want to eat
   o Enough but not always the kinds of food we want
   o Sometimes not enough to eat
   o Often not enough to eat
   o Choose not to answer

7. Once you have fallen asleep, how long do you sleep for?
   o \( \leq 6 \) hours
   o 7 hours
   o 8 hours
   o \( \geq 9 \) hours
**Dietary Screener Questionnaire (DSQ)**

These questions are about foods you ate or drank during the past month, that is, the past 30 days. When answering, please include meals and snacks at home, at work or school, in restaurants, and anyplace else.

Mark an √ to indicate your answer. To change your answer, completely fill the box for the incorrectly marked answer (X). Then mark an √ in the correct one. Your answers are important.

1. How old are you (in years)?

   ______ Years

2. Are you male or female?

   □ Male
   □ Female

3. During the past month, how often did you eat hot or cold cereals, oatmeal, or porridge made by cereal (black rice porridge, millet congee, hominy and kasha, etc.)? Do not include rice gruel. Mark one √.

   □ Never √ Go to question 4
   □ 1 time last month
   □ 2-3 times last month
   □ 1 time per week
   □ 2 times per week
   □ 3-4 times per week
   □ 5-6 times per week
   □ 1 time per day
   □ 2 or more times per day

4. During the past month, what kind of cereal did you usually eat? –Print cereal.

   ______________________________________________________

5. If there was another kind of cereal that you usually ate during the past month, what kind was it? –Print cereal, if not leave blank.

   ______________________________________________________
6. During the past month, how often did you have any milk (either to drink or on cereal)? Include regular milks, chocolate or other flavored milks, lactose-free milk, buttermilk. Please do not include soy milk or small amounts of milk in coffee or tea.
   - Never → Go to question 8
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2-3 times per day
   - 4-5 times per day
   - 6 or more times per day

7. During the past month, what kind of milk did you usually drink?
   - Whole or regular milk
   - 2% fat or reduced-fat milk
   - 1%, ½ %, or low-fat milk
   - Fat-free, skim or non fat milk
   - Soy milk
   - Other kind of milk – Print milk.

8. During the past month, how often did you drink regular soda or pop that contains sugar (cola, sprite)? Do not include diet soda or zero soda.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2-3 times per day
   - 4-5 times per day
   - 6 or more times per day
9. During the past month, how often did you drink 100% pure fruit juices such as orange, mango, apple, grape and pineapple juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home with sugar added.

☐ Never
☐ 1 time last month
☐ 2-3 times last month
☐ 1 time per week
☐ 2 times per week
☐ 3-4 times per week
☐ 5-6 times per week
☐ 1 time per day
☐ 2-3 times per day
☐ 4-5 times per day
☐ 6 or more times per day

10. During the past month, how often did you drink coffee or tea that had sugar or honey added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Iced Tea and Frappuccino. Include sweetened coffee and tea you purchased from markets such as Nescafe, Master Kong Green Ice Tea or Black Ice Tea. Do not include artificially sweetened coffee or diet tea.

☐ Never
☐ 1 time last month
☐ 2-3 times last month
☐ 1 time per week
☐ 2 times per week
☐ 3-4 times per week
☐ 5-6 times per week
☐ 1 time per day
☐ 2-3 times per day
☐ 4-5 times per day
☐ 6 or more times per day

11. During the past month, how often did you drink sweetened fruit drinks, sports or energy drinks, such as Kool-Aid, lemonade, Hi-C, cranberry drink, Gatorade, Red Bull or Vitamin Water? Include fruit juices you made at home and added sugar to. Do not include diet drinks or artificially sweetened drinks.

☐ Never
☐ 1 time last month
☐ 2-3 times last month
☐ 1 time per week
☐ 2 times per week
☐ 3-4 times per week
☐ 5-6 times per week
☐ 1 time per day
☐ 2-3 times per day
☐ 4-5 times per day
☐ 6 or more times per day
12. During the past month, how often did you eat fruit? Include fresh, frozen or canned fruit. Do not include juices.
  - Never
  - 1 time last month
  - 2-3 times last month
  - 1 time per week
  - 2 times per week
  - 3-4 times per week
  - 5-6 times per week
  - 1 time per day
  - 2 or more times per day

13. During the past month, how often did you eat a green leafy (spinach, bok choy, Chinese cabbage, amaranth, rape, leek, coriander, bolt, kale, collards, mustard greens or lettuce etc., with or without other, vegetables?)
  - Never
  - 1 time last month
  - 2-3 times last month
  - 1 time per week
  - 2 times per week
  - 3-4 times per week
  - 5-6 times per week
  - 1 time per day
  - 2 or more times per day

14. During the past month, how often did you eat any kind of fried potatoes, including French fries, hash brown potatoes, or stir fries with little oil,?
  - Never
  - 1 time last month
  - 2-3 times last month
  - 1 time per week
  - 2 times per week
  - 3-4 times per week
  - 5-6 times per week
  - 1 time per day
  - 2 or more times per day
15. During the past month, how often did you eat any other kind of potatoes, such as baked, boiled, mashed potatoes, sweet potatoes, or potato salad?
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day

16. During the past month, how often did you eat tofu, or beans including refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? Do not include green beans.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day

17. During the past month, how often did you eat brown rice or other cooked (fried-pan cake, steamed) whole grains such as wheat, cracked wheat, corn, red rice, black rice, sorghum, barley or millet? Do not include white rice.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day
18. During the past month, not including what you just told me about (green salads, potatoes, cooked dried beans/tofu), how often did you eat other vegetables, such as mushrooms, seaweed, agaric, laver, broccoli, bean sprout, lotus root, peas, carrot, white radish, eggplants, melon vegetables, onion, celery, green beans, garlic, cauliflower etc.? Do not include tomatoes.

- [ ] Never
- [ ] 1 time last month
- [ ] 2-3 times last month
- [ ] 1 time per week
- [ ] 2 times per week
- [ ] 3-4 times per week
- [ ] 5-6 times per week
- [ ] 1 time per day
- [ ] 2 or more times per day

19. During the past month, how often did you have Mexican-type salsa or other dishes made with tomato, like scrambled egg with tomato, braised beef brisket with tomato? Do not include tomato soup or ketchup.

- [ ] Never
- [ ] 1 time last month
- [ ] 2-3 times last month
- [ ] 1 time per week
- [ ] 2 times per week
- [ ] 3-4 times per week
- [ ] 5-6 times per week
- [ ] 1 time per day
- [ ] 2 or more times per day

20. During the past month, how often did you eat pizza? Include frozen pizza, fast food pizza, and homemade pizza.

- [ ] Never
- [ ] 1 time last month
- [ ] 2-3 times last month
- [ ] 1 time per week
- [ ] 2 times per week
- [ ] 3-4 times per week
- [ ] 5-6 times per week
- [ ] 1 time per day
- [ ] 2 or more times per day
21. During the past month, how often did you have tomato soup or tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? Do not include tomato sauce on pizza.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day

22. During the past month, how often did you eat any kind of cheese? Include cheese as a snack, cheese on burgers, sandwiches, and cheese in foods such as lasagna, quesadillas, or casseroles, sweet potatoes, bread. Do not include cheese on pizza.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day

23. During the past month, how often did you eat red meat, such as beef, pork, ham, lamb or sausage? Do not include chicken, turkey, duck or seafood. Include red meat you had in sandwiches, lasagna, stew, and other mixtures. Red meats may also include veal, lamb, and any lunch meats made with these meats.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day
24. During the past month, how often did you eat any processed meat, such as bacon, lunch meats, or hot dogs? Include processed meats you had in sandwiches, soups, pizza, casseroles, and other mixtures. Processed meats are those preserved by smoking, curing, or salting, or by the addition of preservatives. Examples are: ham, bacon, pastrami, salami, sausages, bratwursts, frankfurters, hot dogs, and spam.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day

25. During the past month, how often did you eat whole grain bread including toast, rolls and in sandwiches and cereal buns? Whole grain breads include whole wheat, rye, oat and pumpernickel, corn, millet, barley, buckwheat, etc. Do not include white bread or white steam bun.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day

26. During the past month, how often did you eat chocolate or any other types of candy? Do not include sugar-free candy.

- Never
- 1 time last month
- 2-3 times last month
- 1 time per week
- 2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 or more times per day
27. During the past month, how often did you eat doughnuts, sweet rolls, Danish, muffins, pan dulce, pop-tarts, or custard tart? Do not include sugar-free items.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day

28. During the past month, how often did you eat cookies, cake, pie, fruit filled pastry, or brownies? Do not include sugar-free kinds.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day

29. During the past month, how often did you eat ice cream or other frozen desserts? Do not include sugar-free kinds.
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day

30. During the past month, how often did you eat popcorn?
   - Never
   - 1 time last month
   - 2-3 times last month
   - 1 time per week
   - 2 times per week
   - 3-4 times per week
   - 5-6 times per week
   - 1 time per day
   - 2 or more times per day
Dietary Behaviors Questionnaire

Think about before you moved to the United States, please provide us with the following information about your typical dietary behavior.

1. When you were at your home country, how often did you consume takeaway food as a main meal?
   - Never
   - <1 meal/week
   - About 1 meal/week
   - ≥2 meals/week

2. When you were at your home country, how often did you consume convenience food as a main meal?
   - Never
   - <1 meal/week
   - About 1 meal/week
   - ≥2 meals/week

3. When you were at your home country, how often did you eat at a restaurant, cafe´ or pub for a main meal?
   - Never
   - <1 meal/week
   - About 1 meal/week
   - ≥2 meals/week

4. When you were at your home country, how often did you eat breakfast?
   - Always
   - Often
   - Seldom/Never

5. When you were at your home country, how many meals did you eat per day?
   - ≤2 times
   - 3 times
   - 4 times

6. When you were at your home country, did you often shop food by yourself?
   - Yes, do own food shopping
   - No, don’t do own food shopping

7. When you were at your home country, how often did you cook meals at home?
   - Daily
   - 3 times/week
   - 1 time/week
   - Rarely (once per month/special occasion)
International Physical Activity Questionnaire (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous and moderate activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY
The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?
   - Yes
   - No ------Skip to PART 2: TRANSPORTATION

The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time.
   - ______ days per week
   - No vigorous job-related physical activity ------Skip to question 4

3. How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?
   - _____ hours per day
   - _____ minutes per day

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.
   - ______ days per week
   - No moderate job-related physical activity ------Skip to question 6

5. How much time did you usually spend on one of those days doing moderate physical activities as part of your work?
   - _____ hours per day
   - _____ minutes per day
6. During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work.
   • _____ days per week
   • No job-related walking ------Skip to PART 2: TRANSPORTATION

7. How much time did you usually spend on one of those days walking as part of your work?
   • _____ hours per day
   • _____ minutes per day

PART 2: TRANSPORTATION PHYSICAL ACTIVITY
These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus, car, or tram?
   • _____ days per week
   • No traveling in a motor vehicle ------Skip to question 10

9. How much time did you usually spend on one of those days traveling in a train, bus, car, tram, or other kind of motor vehicle?
   • _____ hours per day
   • _____ minutes per day

Now think only about the bicycling and walking you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?
    • _____ days per week
    • No bicycling from place to place ------Skip to question 12

11. How much time did you usually spend on one of those days to bicycle from place to place?
    • _____ hours per day
    • _____ minutes per day

12. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?
    • _____ days per week
    • No walking from place to place ------Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

13. How much time did you usually spend on one of those days walking from place to place?
    • _____ hours per day
    • _____ minutes per day
PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY
This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, chopping wood, shoveling snow, or digging in the garden or yard?
   • _____ days per week
   • No vigorous activity in garden or yard ------Skip to question 16

15. How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?
   • _____ hours per day
   • _____ minutes per day

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?
   • _____ days per week
   • No moderate activity in garden or yard ------Skip to question 18

17. How much time did you usually spend on one of those days doing moderate physical activities in the garden or yard?
   • _____ hours per day
   • _____ minutes per day

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?
   • _____ days per week
   • No moderate activity inside home ------Skip to PART 4: RECREATION,

SPORT AND LEISURE-TIME PHYSICAL ACTIVITY
19. How much time did you usually spend on one of those days doing moderate physical activities inside your home?
   • _____ hours per day
   • _____ minutes per day

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY
This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.
20. Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?
   - _____ days per week
   - No walking in leisure time ------ Skip to question 22

21. How much time did you usually spend on one of those days walking in your leisure time?
   - _____ hours per day
   - _____ minutes per day

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?
   - _____ days per week
   - No vigorous activity in leisure time ------ Skip to question 24

23. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?
   - _____ hours per day
   - _____ minutes per day

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?
   - _____ days per week
   - No moderate activity in leisure time ------ Skip to PART 5: TIME SPENT SITTING

25. How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?
   - _____ hours per day
   - _____ minutes per day

PART 5: TIME SPENT SITTING
The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the last 7 days, how much time did you usually spend sitting on a weekday?
   - _____ hours per day
   - _____ minutes per day

27. During the last 7 days, how much time did you usually spend sitting on a weekend day?
   - _____ hours per day
   - _____ minutes per day
**Vancouver Index of Acculturation (VIA)**

Please circle one of the numbers to the right of each question to indicate your degree of agreement or disagreement. Many of these questions will refer to your heritage culture, meaning the original culture of your family (other than American). It may be the culture of your birth, the culture in which you have been raised, or any culture in your family background. If there are several, pick the one that has influenced you most (e.g. Irish, Chinese, Mexican, African). If you do not feel that you have been influenced by any other culture, please name a culture that influenced previous generations of your family.

Your heritage culture (other than American) is: _________________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Disagree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I often participate in my heritage cultural traditions.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>2. I often participate in mainstream American cultural traditions.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>3. I would be willing to marry a person from my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>4. I would be willing to marry a white American person.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>5. I enjoy social activities with people from the same heritage culture as myself.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>6. I enjoy social activities with typical American people.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>7. I am comfortable interacting with people of the same heritage culture as myself.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>8. I am comfortable interacting with typical American people.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>9. I enjoy entertainment (e.g. movies, music) from my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>10. I enjoy American entertainment (e.g. movies, music).</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>11. I often behave in ways that are typical of my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>12. I often behave in ways that are typically American.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>13. It is important for me to maintain or develop the practices of my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>14. It is important for me to maintain or develop American cultural practices.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>15. I believe in the values of my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>16. I believe in mainstream American values.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>17. I enjoy the jokes and humor of my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>18. I enjoy white American jokes and humor.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>19. I am interested in having friends from my heritage culture.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>20. I am interested in having white American friends.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
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</tbody>
</table>
The following additional questions ask you about your acculturation experience at the university.

Please circle one of the numbers to the right of each question to indicate your degree of agreement or disagreement.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Disagree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I communicate effectively when I am speaking in English.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I communicate effectively when I am writing in English.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
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<tr>
<td>3</td>
<td>I can understand lectures given in English at my university.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
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<tr>
<td>4</td>
<td>I feel comfortable participating in meetings with Americans.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I feel comfortable participating in clubs or other university organizations.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I use social media to be a part of my heritage culture society.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I use social media to be a part of American society.</td>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
</tbody>
</table>
**Acculturative Stress Scale for Chinese Students (ASSCS)**

This scale describes some stressful situations that might occur to you after you come to the U.S.

Please write the number that BEST describes your experience, using following scale:

1=never  
2-3=sometimes  
4-5=often  
6-7=all the time.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>I hesitate to participate in class discussion and seminar.</td>
</tr>
<tr>
<td>2.</td>
<td>My social circles shrank after I come to the U.S.</td>
</tr>
<tr>
<td>3.</td>
<td>I feel that I receive unequal treatment.</td>
</tr>
<tr>
<td>4.</td>
<td>I feel helpless.</td>
</tr>
<tr>
<td>5.</td>
<td>I feel a lot of academic pressure.</td>
</tr>
<tr>
<td>6.</td>
<td>I am treated differently because of my race.</td>
</tr>
<tr>
<td>7.</td>
<td>It is hard for me to follow the lectures and conversations in classes.</td>
</tr>
<tr>
<td>8.</td>
<td>I cannot express myself very well when using English.</td>
</tr>
<tr>
<td>9.</td>
<td>I do not have many friends in the U.S.</td>
</tr>
<tr>
<td>10.</td>
<td>I don’t feel a sense of belonging (community) here.</td>
</tr>
<tr>
<td>11.</td>
<td>People from some other ethnic groups show hatred toward me.</td>
</tr>
<tr>
<td>12.</td>
<td>I worry about my parents.</td>
</tr>
<tr>
<td>13.</td>
<td>I feel nervous to communicate in English.</td>
</tr>
<tr>
<td>14.</td>
<td>I feel that others are biased toward me.</td>
</tr>
<tr>
<td>15.</td>
<td>I often have to work overtime in order to catch up.</td>
</tr>
<tr>
<td>16.</td>
<td>I feel bored here.</td>
</tr>
<tr>
<td>17.</td>
<td>I feel that my people are discriminated against.</td>
</tr>
<tr>
<td>18.</td>
<td>I feel frustrated that I am not able to participate in class discussions.</td>
</tr>
<tr>
<td>19.</td>
<td>I feel guilty to leave my family and friends behind.</td>
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<td></td>
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<td>---</td>
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</tr>
<tr>
<td>20.</td>
<td>I am not used to the English way of thinking.</td>
</tr>
<tr>
<td>21.</td>
<td>I have limited social life.</td>
</tr>
<tr>
<td>22.</td>
<td>I feel angry that my people are considered inferior here.</td>
</tr>
<tr>
<td>23.</td>
<td>I lack confidence when I have to do presentations in English.</td>
</tr>
<tr>
<td>24.</td>
<td>The intensive study makes me sick.</td>
</tr>
<tr>
<td>25.</td>
<td>I feel guilty that I cannot take care of my parents.</td>
</tr>
<tr>
<td>26.</td>
<td>My vocabulary is so small that I always feel short of words.</td>
</tr>
<tr>
<td>27.</td>
<td>I feel lonely in the U.S.</td>
</tr>
<tr>
<td>28.</td>
<td>I feel some people don’t associate with me because of my ethnicity.</td>
</tr>
<tr>
<td>29.</td>
<td>It is a big pressure for me to publish academic paper in English.</td>
</tr>
<tr>
<td>30.</td>
<td>I shy away from social situations due to my limited English.</td>
</tr>
<tr>
<td>31.</td>
<td>I do not have new social network here.</td>
</tr>
<tr>
<td>32.</td>
<td>Academic pressure has lowered the quality of my life.</td>
</tr>
</tbody>
</table>
APPENDIX B
PROTOCOL FOR IPAQ SCORING

Protocol for IPAQ scoring was based on International Physical Activity Questionnaire website (81).

Domain specific scores are calculated by summation of scores for all activities within the specific domain.

WORK DOMAIN: Walk (METs×min×days) + Mod(METs×min×days) + Vig (METs×min×days) at WORK
TRANSPORTATION: Walk (METs×min×days) + Cycle (METs×min×days) for TRANSPORTATION
DOMESTIC AND GARDEN: Vig (METs×min×days) at YARD + Mod (METs×min×days) at YARD + Mod (METs×min×days) INSIDE HOME
LEISURE-TIME: Walk(METs×min×days) +Moderate(METs×min×days) +Vigorous(METs×min×days) in LEISURE-TIME

Activity specific scores will be calculated by summation of scores for specific type of activity over all domains.

Total Walking MET-minutes/week= Walk (at Work + Transport + Leisure-time)
Total Moderate MET-minutes/week= Cycle for transport + Mod (at work + Yard + Inside home + Leisure)
Total Vigorous MET-minutes/week=Vig (at Work + Leisure)

Total Physical Activity Score will be calculated by the summation of all the types of activities in all domains.

Total Physical Activity MET-minutes/week = Total Walk MET-minutes/week + Total Moderate MET-minutes/week + Total Vigorous MET-minutes/week
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78. Scott M. "Customer research easier in digital era". USA Today. Customer research easier in digital era. USA Today. 27 August 2012.


81. IPAQ. self-admin International Physical Activity Questionnaire https://sites.google.com/site/theipaq/ assessed March 4, 20172010.


BIOGRAPHICAL SKETCH

Xiaoyu Zhang was born and grew up in eastern China, Zhejiang Province. She graduated with her Bachelor of Agronomy in 2015 from the Huazhong Agricultural University in Wuhan, China. And then she pursued a master's degree in food science and human nutrition at the University of Florida, at the same time, she earned a minor in statistics.