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Identifying factors affecting nutrition transition of young adults in Hebei, China

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Identifying factors affecting nutrition transition of young adults in Hebei, China

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CHAPTER 1. INTRODUCTION

The growing epidemic of chronic diseases around the world increases the burden from disease for the whole world. In 2001, the deaths caused by chronic diseases were approximately 60% of the total reported deaths in the world (1); and it has been projected that this percentage will increase to 75% by 2020 (2). Chronic diseases are no longer limited to developed countries, as globalization is taking place and the traditional diet and life style are also changing. Among all the deaths that are attributable to chronic diseases in the world, 79% now occur in the developing countries (3). It is projected that by 2020, 71% of deaths due to ischemic heart disease (IHD), 75% of deaths due to stroke, and 70% of deaths due to diabetes will occur in developing countries (2).

Diet and nutritional status have been known for many years to be important modifiable risk factors of chronic diseases (4). However, in developing countries the traditional largely plant-based diets are being replaced by energy-dense diets incorporating more animal foods, fat, and less fiber (4). This kind of diet change, together with an increasing of sedentary lifestyle and other risk factors, are projected to increase the already heavy burden of chronic diseases in developing countries (4).

The theory of nutrition transition has been proposed to describe a sequence of characteristic changes in the overall dietary patterns that happen in a certain period of human history resulting from the changes of economic, social, demographic, and health factors in human society (5). The current acceleration in nutrition transition taking place in developing countries is different from the past experience in the western countries (6). The dietary shift that took place within one to two centuries in the West is now occurring within a few decades

in the developing world (6). China is an example of a developing country with rapid urbanization related to rural-urban migration and great economic disparities within the country. Economic changes are reflected in dietary changes. From 1982 to 1992, the national consumption of cereals and fiber decreased by 12% and 47% respectively while meat, egg, and fat consumption increased by 38%, 60%, and 61% (7).

To better understand the emerging dietary patterns in different socioeconomic groups in China and possible social, cultural, economic, attitudinal, and behavioral factors affecting the nutrition transition in China, a cross-sectional study was designed to measure the dietary intake and to assess nutrition transition related attitudes and behaviors of young adults within four different socioeconomic groups including urban high-income group, urban low-income group, rural-urban migration group, and rural-living group. This dissertation has three foci. First, to compare the nutrition intake of different socioeconomic groups; Secondly, to identify factors related to nutrition transition in China; and finally, to report urban effects on dietary transition and discovered factors associated with those effects. The results of this study can be used to inform community health educators of the existing nutrition problems in China, and to point out the most serious problems for the most vulnerable population groups that need special attention. This study supplies public health decision makers and educators with theory-guided research findings on modifiable factors affecting nutrition transition, which will help them design nutrition intervention programs in the future. The research design and its findings may be utilized by other developing countries since the globalization is impacting all the developing countries worldwide with various rates of economic development.

The organization of the dissertation is listed as follows: Chapter 1 is the general introduction of the dissertation; Chapter 2 reviews the literature in related research areas; Chapter 3 is a journal manuscript which describes the design and the methodology of the preliminary study and reported its results; Chapter 4 is a second manuscript focusing on identifying factors predicting nutrition transition behaviors in Chinese young adults; Chapter 5 is a third manuscript reporting the results of urbanization effects on dietary transition by studying rural-urban migration and rural-living young adults; and Chapter 6 is a brief conclusion outlining future potential research suggestions.

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CHAPTER 2. LITERATURE REVIEW

Dietary Patterns and Economic Development

Dietary patterns are associated with social and economic factors and nutrition transition will follow specific sequence of stages according to Popkin's model: collecting food, famine, receding famine, degenerative disease and behavioral change stage (1). Popkin's nutrition transition model is shown in Figure 1. In Popkin's model there was no agriculture practice before the famine stage. In the famine stage, a region's economy is underdeveloped with basic agriculture practice of raising grain and animal husbandry for family use with little marketing. People have little diet variety and cereals are their major energy and nutrient source. Preventing nutritional deficiency diseases among infants and children is a major concern at that stage.

In the following stage of receding famine, the second agricultural and industrial revolution occurred; diets have fewer starchy products and more fruits, vegetables and animal protein than in previous stage. Many nutritional deficiencies disappear with improved nutritional status.

In the degenerative disease phase, the dietary pattern includes more fat, sugar, animal products and less fiber. Development of obesity and chronic health problems are major nutritional problems. This stage is marked by the technology revolution resulting in decreased demand for physical labor. With further understanding of the relationship between nutrition and health, more people have realized the importance of increasing carbohydrate, fruit and vegetable intake and decreasing fat intake resulting in the transition from degenerative disease pattern to behavioral change pattern.

Nutrition transition is defined by Popkin as "a term used to describe shifts in diet, physical activity, health, and nutrition—can be traced to higher incomes, the influence of mass media and food marketing, and a range of changes in the nature of work and leisure" (2). Popkin also proposed that the position a person holds in the nutrition transition could be qualitatively measured and was determined by a person's dietary change from a traditional diet to a westernized diet, physical activity, and body composition (2). Based on this principle, Popkin points out in several of his published articles (1, 2, 3) that urban areas in developing countries have moved further along the nutrition transition continuum than rural areas in those countries.

The Association between Diet and Chronic Diseases with Economic Development in Developing Countries

With economic development, dietary patterns are changing from the famine stage, through the receding famine stage to the degenerative disease stage in relatively wealthy areas in developing countries. In a recent study in Papua New Guinea, dietary analysis indicated that the urban residents in Papua New Guinea had less whole grains and more refined grains, and red and processed meats due to the adoption of a western lifestyle than the traditional society of Papua New Guinea (4). Among the urban population, the number of cases of atheroma-related cardiovascular diseases increased in Papua New Guinea although in the traditional rural society atherosclerotic cardiovascular diseases are rare (4). Individuals from remote villages of Samberigi (n=123) and their relatives who had lived in Port Moresby city continuously for a minimum of 5 years (n=98) were surveyed in that study and the mean plasma total cholesterol, low-density lipoprotein cholesterol (LDLC), high-density

lipoprotein cholesterol (HDLC), fasting blood glucose and HbA1c were significantly higher in the urban group (4). These results indicated a significant increase in CVD risk factors in the urban population in that country.

In developed countries, an epidemic of coronary heart disease began after World War I and has reached its peak in the 1970's. In most developing countries, the epidemic began after World War II with the rapid economic development and is increasing rapidly (5). An epidemic study in Shanghai, China showed that from 1951 to 1998, leading cause of deaths shifted from infectious diseases to non-communicable diseases (NCDs) and the three leading causes of deaths; i.e. tumor, cardio-vascular, and respiratory diseases, accounted for 75% of all deaths. Mortality due to tumor began to increase in the late 1970s; coronary heart diseases began to increase in late 1980s, and stoke began to increase in the early 1990s (6). Among adults in Thailand, the problem of overweight and other risk factors for CVD have increased significantly in relation to social and economic changes and the leading causes of deaths are diet-related chronic degenerative diseases (7). Deaths from the cardiovascular system have become the number one cause in Thailand; and deaths from cancers, number three since the late 1980s (7). Another study in Malaysia showed that the accelerated industrialization and urbanization in recent decades has resulted in changes in dietary habits and sedentary lifestyles(8). Over the last two decades Malaysia has experienced rapid growth of the fast food industry with increased intake of total calories, fats and sugars. Those food consumption patterns related to the nutrition transition in Malaysia are responsible for the increasing of diet-related chronic diseases in the population (8). These studies indicate that dietary intake is closely related to the increase of chronic diseases and especially important in preventing those diseases during socioeconomic transition in developing countries.

Urbanization and Diet

The population in developing countries is quickly becoming urbanized as people migrate from rural villages to the cities. Developing countries have a high speed of urbanization with the urban growth rate of developing regions reaching 3.0 percent per year in 1995-2000, and this rate is projected to remain high in the urban areas of less developed regions with an estimated average of 2.4 percent change per year during 2000-2030 (9). Fifty years ago only 18% of people in developing countries lived in cities (10). In 2000 the proportion was 40%, and it is estimated that by 2030, 56% of the population in the developing world will be urban (11).

The diets of urban residents contains more refined carbohydrates, animal foods, processed foods, and saturated and total fat and less fiber than the diets consumed by rural residents in developing countries and this difference existing between urban and rural diets and this pattern has been observed even in the poorest areas of very low-income countries (2). The diets of urban dwellers are more diversified and rich in micronutrients than the diets consumed in rural areas (2). Urban areas in developing countries moved further along the nutrition transition process than rural areas in those countries (2).

Urbanization is believed to be one of the factors that drive the large shifts in diet and activity patterns, especially changes in their structure and overall composition (12). Increased income is known to have relationship with the urban effects on these dietary changes (1). However, it can only partially explain the urban effects (2). Researchers found that urban residence affected the likelihood of consuming selected food groups and the consumption of certain food group when income, food price, and a range of other sociodemographic variables were controlled for (13). It has been proposed that the use of mass media and

modern marketing approaches may account for the urban residents' diet changes (2). However, the understanding of the impact of media and marketing on the nutrition transition is still limited. The availability of a large amount of low-priced edible oils in developing countries has increased tremendously due to new technologies, which was considered as another possible reason for the urban effects on the diet change (2). In general, it is still not clear what factors in addition to higher incomes and lower food prices have a caused effect relationship with the urban effect on the diet change and it has not been determined if those possible factors worked synergistically to create the effect of urban residence on diet change (1).

Nutrition Problems in China

Data from national surveys of dietary intake in China indicated that the traditional Chinese diet is shifting to a pattern that is more like the typical western diet (14, 15). There was a reduction of vegetable consumption among Chinese residents now compared with the vegetable consumption 20 years ago, and the intake of animal foods has increased rapidly since 1980. The proportion of energy from fat increased quickly and reached 27.3% in average and 32.8% in urban residents in 1997. More than one third of all Chinese adults and 58.4% of adults in urban areas consumed over 30% of their energy from fat in 1997. From 1989 to 2000, the percentage of adults in China with >30% of energy intake from fat almost tripled (from 15% to 44%) (13). Increased consumption of animal foods and fat resulted in a rapid increase of the prevalence of overweight and obesity in urban residents, which caused increased incidence of chronic disease. Although China has the same nutrition problems as other developing countries where malnutrition and over nutrition coexist, it has been

observed that there was a prevalence of households having both overweight and underweight members in China (16). The economic burden caused by diet-related noncommunicable diseases has now surpassed the economic cost of malnutrition in China (2).

With economic development, social disparities have increased rapidly, especially between urban and rural areas. In Zhejiang province located in Eastern China, the mean body mass index (BMI) was significantly higher in young adult adolescents in urban Hangzhou than in rural Chunan (17). Rural young adolescents had a less varied diet and the mean hemoglobin level was significantly lower in the rural area. Another study in Jilin Province in northeast China observed higher intake of protein, animal protein, and fat intake in urban adult women in their capital than in their counterparts in villages (18). These authors concluded that major nutrition problems are different in urban and rural areas: nutrition deficiency is still the most important problem in rural areas, and over nutrition, in urban areas.

Nutrition education is still limited in both urban and rural sites. Large scaled, theory-based nutrition education has seldom been implemented and evaluated in either urban or rural sites. In a survey investigating nutrition knowledge-attitudes-practices (KAP) of urban and rural residents in Sichuan Province in Mid-west, China, though both urban and rural residents expressed favorable attitudes toward nutrition education, they had low nutrition knowledge levels and a poor understanding of the relationship between nutrition and certain common diseases, which resulted in less than optimum diet habits for preventing nutrition deficiencies or reducing the risk of chronic disease in both urban and rural residents (19). That study also suggested that nutrition education should be tailored to satisfy different needs of urban and rural residents to obtain good results.

Theoretical Framework

The PRECEDE-PROCEED model was designed by Green and Kreuter to explain health-related behaviors and to design and evaluate the health promotion programs targeting at factors influencing health-related behaviors (20). This model demonstrates that the nature of health-related behaviors is voluntary and successful intervention programs change behaviors by influencing the precursors to behaviors through predisposing, enabling, and reinforcing factors (20). Predisposing factors include people's knowledge, attitude, cultural beliefs, readiness to change, health concerns, and perceived health benefits, which provide the motivation behind a behavior (20). Enabling factors empower motivation to act and these factors include food availability, accessibility, and cost (20). Reinforcing factors are continuing rewards received by learners after they adopt a behavior to encourage the continuation of the behavior (20). Taste, emotional factors associated with food intake, social support, praise, reassurance, and symptom relief are all reinforcing factors (21, 22).

The advantage of the PRECEDE-PROCEED model is that it can incorporate existing theories and constructs into a comprehensive systematic overview to understand health-related behavior changes by using existing theories to guide the examination of factors in the predisposing, enabling, and reinforcing constructs. A fundamental concept in the PRECEDE-PROCEED model is that health and health risks are caused by multiple factors; and thus, all the efforts or interventions working for the change of health behaviors must be multidimensional incorporating changes of behavioral, environmental, and social factors (22). It is important to realize that any plan to influence health behaviors must consider all three constructs of predisposing factors, enabling factors, and reinforcing factors**.** Identifying

and sorting factors into the three construct and building up the complete theoretical framework is the first step for planning interventions to modify behavioral changes (23).

The PRECEDE-PROCEED model provides practitioners in various professions with clear guidelines and a systematic framework to plan, deliver, and evaluate health programs and this model has been applied, tested, and verified in many studies in community, school, clinical, and workplace settings over the last decade. The Institute of Health Promotion Research at University of British Columbia has a website of the published applications of the Precede model at http://www.ihpr.ubc.ca/ProcedeRefs.html. The PRECEDE-PROCEED model was used to identify the relevant behavioral and environmental risk factors associated with various health problems in a number of rigorously evaluated, randomized clinical and field trials. For example, the PRECEDE-PROCEED model was used as a basis for planning a three-year intervention trial that aims to reduce injury to child pedestrians (24). In that study, researchers used this model to identify the associated risk factors associated with child pedestrian injuries in the target areas and further delineated modifiable causes of those behavioral and environmental risk factors (24). Based on the results of the factor identification, the child pedestrian injury prevention program was planned. In another research carried out by Chang et al; the predisposing, enabling, and reinforcing constructs of the PRECEDE-PROCEED model were used to test reliability and validity of selected factors adapted from the questionnaires measuring fat intake behaviors of low-income mothers (21). The study design of this experiment demonstrated the advantage of the PRECEDE-PROCEED model to integrate components of existing theories and build a complex system model. In that study factors were chosen from the questionnaires according to some established theories: components of the Health Belief Model, Social Learning Theory, and

the Triandis Model were separated into three constructs and were integrated into a comprehensive framework based on the PRECEDE-PROCEED model. The success of that study further demonstrated the consistency of the PRECEDE-PROCEED model in explaining dietary intake behaviors and supported the utilization of the PRECEDE-PROCEED model in research studying why and how diet-related behaviors changed.

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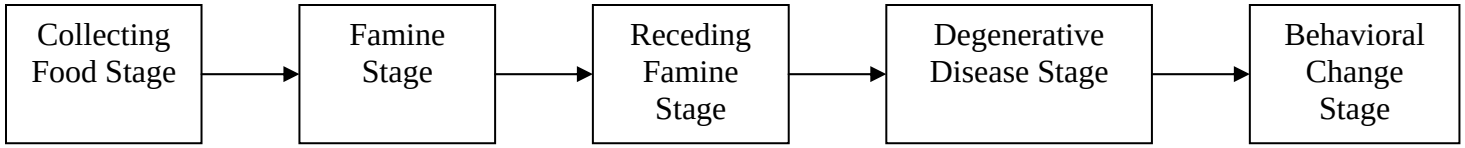
Figure 1. Stages of nutrition transition. Source: Popkin BM. Urbanization, lifestyle changes and the nutrition transition. World development 1999;27(11):1905-1916.



Economic transition	No agricultural practice	A region's economy is underdeveloped with basic agriculture practice of raising grain and animal husbandry for family use with little marketing	The second agricultural and industrial revolution occurred	The technology revolution resulting in decreased demand for physical labor	Further multidisciplinary technology happens across all dimensions of life: social, economic, political, and personal
Diet	Plants, low-fat wild animals; varied diet	Cereals predominant; diet less varied	Fewer starchy staples; more fruits, vegetables, animal protein; low variety continues	More fat (especially from animal products), sugar and processed foods; less fiber	Less fat and processing; increased carbohydrates, fruits and vegetables
Nutritional status	Robust, lean, few nutritional deficiencies	Children, women suffer most from low fat intake; nutritional deficiency diseases emerge; stature declines	Continued mother and children nutrition problems; many deficiencies disappear; weaning diseases emerge; stature grows	Obesity; problems for elderly (bone health, etc.); many disabling conditions	Reduced body fat levels and obesity; improved bone health

CHAPTER 3. NUTRITION TRANSITION IN DIFFERENT SOCIOECONOMIC SUBGROUPS: A CASE STUDY IN HEBEI PROVINCE, CHINA

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Abstract

Objective: To study dietary intake and physical activity levels of different socioeconomic groups in China including urban-living high- and low- income young adults and low-income young adults who migrated to urban from rural areas and their attitudes toward a westernized diet and life style.

Design: Cross-sectional.

Participants: Randomly selected urban-living high- and low- income young adults (n=10 and 11) and a convenience sample of rural-urban migration young adults (n=22).

Variables measured: Demographic characteristics, fruit and vegetable intake and Stage of Change for classification of intention to eat fruits and vegetables, dietary intake, food purchasing, preparation, and eating out behaviors, attitude and intention toward nutrition transition related items, and physical activity.

Analysis: One-way ANOVA, t-test, Eta, linear regression.

Results: The major differences in nutrient intake between high-income and low-income groups were fat, carbohydrate, fiber, and cholesterol intake, and the high-income group had a more westernized dietary pattern than either of the low-income groups. Participants' attitudes and intentions toward a more westernized diet and living style were associated with their Social Economic Status (SES). SES, family size, educational levels, annual income, monthly food expenditure, times of eating out per week, total time of vigorous activity per week, and

intention toward using more cooking oil/fat had linear relationship with the degree of participants' dietary transition. Participants' usual activity required at work, monthly food expenditure, and dietary transition score had linear relationship with their physical activity levels.

Conclusions and implications: Nutrition transition in China is imbalanced in different social economic groups. Interventions are needed in China to decrease the incidence of adverse dietary changes leading to increased risks of developing chronic disease with the special concern for those low-income young adults.

KEY WORDS: nutrition transition, rural-urban migration, low-income, young adults

Introduction

Nutrition transition is a newly emerging global concern in developing countries, and is broadly described as the overall changes in food production, processing, availability, and consumption and changes in anthropometrical measures and physical activity (1, 2). According to Popkin's model dietary patterns are associated with social and economic factors, and nutrition transition will follow specific sequence of stages: collecting food, famine, receding famine, degenerative disease, and behavioral change stage (3). Many developing countries are experiencing a rapid nutrition transition from the stage of receding famine to the stage of degenerative disease as evidenced by increased fat, sugar, animal protein and decreased fruits and vegetables in the diet (3). A subsequent serious outcome of this change in dietary patterns is increased risk for chronic disease. Many studies reported westernization of diet and its relationship with the increased incidence of chronic diseases in

different developing countries (4, 5, 6, 7). Recent projections predict that chronic diseases will account for more than 60% of the total burden of morbidity and mortality in developing countries within twenty years (8). Nutrition education plays a critical role in promoting healthy diet and preventing high incidence of chronic diseases. With timely nutrition education and policy interventions, it may be possible to decrease or avoid the deleterious dietary effects associated with economic transition in developing countries. Therefore, understanding the factors influencing nutrition transition behaviors in developing countries is needed to inform the design of nutrition education materials and programs for those countries. Factors influencing nutrition transition have been shown to vary from country to country and between different subgroups within a country (9), which indicates that exploring factors associated with dietary and nutrition transition need to be done in individual countries involving various subgroups in that society.

China is a developing country undergoing rapid dietary transition. From 1982 to 1992, the national consumption of cereals and fiber decreased by 12% and 47%, respectively while meat, egg, and fat consumption increased by 38%, 60%, and 61%, respectively (10). Hebei province located in northern China has experienced imbalanced economic development. This province not only has highly developed cities but also has the poorest counties in China. The purpose of this study was to investigate factors influencing nutrition transition behaviors in young adult subgroups including high- and low- income urban residents and low-income rural-urban migrants in Hebei province, China. No other reports of studies investigating Chinese rural-urban migrants' nutrition status and nutrition-related behaviors were found in the literature.

Description of Study

Participants and study sites

This study of young adults, age 18 to 24 years old (n=43), in Hebei province, China, was approved by the Institutional Review Board (IRB) at Iowa State University (Appendix 1). Hebei province has a total population of 63.3 million with about one-third of the people (20.1 million) living in the urban areas. Our study site, Shijiazhuang, is the capital of Hebei province with an urban population of 1.5 million. A small sample was selected including urban-living young adults (n=11) from a low-income community with approximately 11000 residents, Xinhaocheng, and urban-living young adults (n=10) from a high-income community with approximately 2300 residents, Hesisuo. Random selection of subjects was made by using the household records and population information maintained by those two communities. A convenience sample of 22 low-income rural-urban migrants was selected from a local pharmaceutical factory in this study. Among all the participants, 23 were male and 20 were female.

Rural-urban migrants are a new low-income population group in China. In 1984 legislation was adopted in China allowing transitory rural-urban migration; and since that time, the population of migrants has increased to 120 million in 2003. Typically, rural-urban migrants do not have any medical insurance and they can usually only afford sub-standard housing in cities. Their work is temporary and they migrate between rural and urban areas. Most of them stay in villages during Spring Festival and return to cities to work after the holiday. When they are unemployed in cities, usually they will return to villages.

Procedures

Survey materials were adapted from previously published questionnaires including Behavioral Risk Factor Surveillance System (BRFSS) 2003 physical activity items (7 items) (11), National Health Interview Survey (NHIS) 2003 (12), and Dietary Acculturation Scales (13). The Staging Algorithm to determine Stage of Change for fruit and vegetable intakes was developed based on the Transtheoretical Model (TTM) (14). The TTM is a model explaining how and why people change addictive behaviors, which consists of several critical components: the stages of change, decisional balance, self-efficacy, and processes of change (15). This model classifies the behavioral transition process into five Stages of Change: Precontemplation, Contemplation, Preparation, Action, and Maintenance. Precontemplation is the stage in which people do not intend to make a behavior change in the foreseeable future; Contemplation is where people are more aware of the pros of changing but are not yet ready for an immediate beginning; People in the Preparation stage intend to take action in a month. Action is the stage where people have made some modifications within the past six months; and in Maintenance, people try to maintain their action and prevent relapse. The TTM applies basic stage construct, together with decisional balance and self-efficacy, provides sensitive measures of progress for behavioral change. The food frequency questionnaire used in this study was developed for the fourth Chinese National Nutrition Survey (16). The fruit and vegetable frequency questionnaires included all commonly available fruits and vegetables based on actual local market studies and focus group discussions. Peer reviewers (n=7) who were experienced in survey development reviewed the instrument for clarity and content validity. Some items have been removed and some

items have been added according to the review. All survey materials were translated into Chinese and back translated into English to ensure their consistency.

Four interns majoring in public health at Hebei Medical University were trained to collect the data in the field. They interviewed the participants at their homes and in the pharmaceutical factory. During face-to-face interviews, trained interns measured the participants' blood pressure, pulse, height and weight and they were asked to finish a chronic disease risk factor survey, a fruit and vegetable frequency questionnaire, a food frequency questionnaire, a Staging Algorithm for fruit and vegetable intake, an attitude and intention toward westernization questionnaire, and a 24-h food recall with the help of our trained interns. There are 3 sections and 36 questions in the chronic disease risk factor survey. Section 1 had 9 questions requesting demographic information. Section 2 had 10 questions about medical history and family history. Section 3 had 4 modules including usual physical activity (7 questions), food and diet related behaviors including food purchasing and preparation and eating out (3 questions), tobacco use (4 questions), and alcohol consumption (3 questions).

Standard bowls, plates, cups, and food models were shown to participants to help them understand serving size and report a more accurate estimation of portion sizes. Nutrient intakes were calculated by using Chinese nutrition database software Nutrition Calculator V1.6 (Chinese CDC Institute of Nutrition and Food Safety and Beijing Feihua Communication and Technology LLC, Beijing,China).

Data coding

The high-income urban group, low-income urban group, and low-income migration group were defined as three different SES groups according to income and type of residence

and were coded as group 1, 2, and 3, respectively. In this study, the criterion for “high-income” was an income higher than 1200 yuan/month and the criterion for "low-income" was an income lower than 500 yuan/month.

Seven categories were used to describe participants’ educational levels: “no school”, “primary school”, “junior high”, “high school”, “technical school”, “college graduates”, and “beyond college degree”, and they were scored from 1 to 7 respectively. Participants’ readiness for increasing fruit and vegetable intake or maintaining ideal intake measured by the Staging Algorithm was scored 0 to 4 for Precontemplation stage, Contemplation stage, Preparation stage, Action stage, and Maintenance stage, respectively.

Two questions with four response categories were used to assess if participants participated in their family’s food purchase and food preparation. The response categories were “almost always”, “about ½ time”, “seldom”, and “never” and scored 1 to 4, respectively. Participants’ attitudes toward consumption of animal foods, refined grains, and regular exercise and their intention to increase consumption of animal foods, fat, processed food, fast food, and regular exercise were rated using six response categories (0-5): “Strongly disagree”, “Disagree”, “Neither agree nor disagree”, “Agree”, “Strongly agree”, and “Do not know”. Responses in category “Do not know” scored 5 and were treated as missing values when correlations were tested.

Percentage of energy intake from protein was separated into three categories: “<12%”, “12% to 16%”, and “>16%”, and scored as –1, 0, and 1 respectively. Percentage of energy intake from fat was separated into five categories, which were “<15%”, “15% to 20%”, “> 20% but < 30%”, “30% to 35%”, and “> 35%” and scored as -2 to 2, respectively. Percentage of energy from carbohydrate was separated into four categories that were

">80%", ">65% but < 80%", "50% to 65%", and "< 50%", which scored as -2 to 1, respectively. Fiber intake had three categories scoring 0 to 2 respectively that were ">15g", "<15g but >= 10g", and "<10g". Cholesterol intake was categorized as "<100mg/day", ">= 100mg/day but < 200mg/day", "200mg/day to 300mg/day", "> 300mg/day but <=700mg/day", and ">700mg/day" and they scored as -2 to 2 respectively. The dietary transition score was calculated as the sum of protein score, carbohydrate score, fat score, fiber score, and cholesterol score. The higher the dietary transition score, the greater the degree of dietary westernization. Possible dietary transition scores ranged from –7 to 7.

Participants reported the amount of time spent each week in various physical activities. Moderate and vigorous physical activities were grouped into four categories and they were "0 to 90 min", "90 to 180 min", "180 to 420 min", and "over 420 min". Those four categories were scored as 0 to 3 and named physical activity scores in the linear regression model.

Statistical analysis

Data were analyzed using SPSS 12.0 for Windows (SPSS, SPSS Inc., Chicago, IL). Statistical significance level was set at α=0.05. One-way ANOVA was carried out to test for differences among the means of variables of three subgroups. Post hoc comparisons were performed to detect differences between means of variables for low- and high-income groups and to detect whether there is any difference between the means of variables of the urban-living group and migration group. Eta was measured to test associations between participants' responses to nutrition transition related questions (dependent and interval variables) and their SES (independent and nominal variable). Linear regression was carried

out to test the linear relationship between dietary transition score and each of participants' socioeconomic and psychological factors and their physical activity levels.

Description of Results

Demographic characteristics

The mean age of young adults (n=43) was 21.4 years (SD= 2.1). More than 50% of participants had a high school or less education, 7% had technical school education, 9.3% had college education, and 27.9% had their education higher than college. All the participants in the urban-living high-income group had completed a college education, and 80% of them had education beyond a college degree. Only 5% of low-income young adults had a college education. Among three subgroups, the rural-urban migration group had the lowest educational levels, and the urban high-income group had the highest educational levels ($P<0.01$).

Young adults in the migration group came from larger families than urban groups ($P=0.0001$, 95% = 1.2 to 2.7), but there was no significant difference in the family size of the two urban groups. Nearly one-quarter of participants were married and one-third of them lived with one or two children. The majority of participants (88.4%) were employed, full- or part-time. The mean annual income of high-income group, urban-living low-income group and low-income rural-urban migrants were 19300 Yuan* (SD=1636), 2963 Yuan (SD=3993), and 3191 Yuan (SD=1874) respectively. The urban high-income group spent 350±87 Yuan on food per month, urban low-income group spent 207±78 Yuan per month, and rural-urban migrants spent 123±82 Yuan per month. Urban high-income group had the highest food expenditure per month and migration group had the lowest food expenditure per month (urban high-income vs. urban low-income $P=0.001$, 95% CI= 65 to 222; urban high-

income vs. migration P=0.0001, 95%CI =154 to 299; urban low-income vs. migration P<0.01, 95% CI=23 to 144).

Among the urban-living participants, 9.5% were smokers. However, 40.9% of migration participants smoked and all of them were male. Mean BMI of participants were 21.25±2.59. None of the participants had been diagnosed with diabetes, impaired glucose homeostasis, or tuberculosis by a physician. However, more than a fifth (20.9%) of participants had been told by a physician that they had hypertension. Nearly 10% of the urban-living young adults had been told by a physician that they had hyperlipidemia. Among all the participants, 4.7% reported that a family member had been diagnosed with diabetes by a physician, 39.5%, cardiovascular diseases; 2.3%, tuberculosis; 14.0%, stroke; and 14.0%, cancer.

Nutrient intakes

The mean total energy intake for participants was 2397±653 kcal for males and 1678±366 kcal for females. There was no significant difference among total energy intake of male participants in the three living groups and there was no significant difference among total energy intake of female participants in the three living groups. The mean percentage of energy from protein was 12.9 ±3.0%, and there was no significant difference among three groups. High-income group had much higher mean percentage of energy from fat than low-income group (33.3±9.1% vs. 20.7±10.6%, P<0.01, 95% CI=5.4 to 19.7%), and there was no significant difference between mean percentages of energy from fat of two low-income groups. High-income group had much lower percentage of energy from carbohydrate than low-income group (53.1±9.6% vs. 65.9±12.7%, P<0.01, 95% CI=5.0 to 20.6%). High-income young adults only had 6.2±3.0 grams of fiber per day, which was significantly lower

than low-income young adults (P=0.0001, 95% CI=2.6 to 7.9). However, even the low-income group did not have adequate fiber intake (11.4±5.0g). There was no significant difference between mean fiber intake of the two low-income groups. High-income young adults had a very high cholesterol intake (606.0±402.4mg/day), which was significantly higher than the mean dietary cholesterol intake for the low-income young adults (145.4±185.1mg/day) (P<0.01, 95%CI=168.7 to 752.3). There was no significant difference between the mean cholesterol intake of low-income urban-living group and migrants. The mean vitamin A intake of all the participants was 367±321μg, and there was no significant difference among three groups. Young adults also had inadequate calcium, zinc, and selenium intakes (409±197mg, 10.9±7.8mg, and 42.3±21.6μg respectively). There was no significant difference in calcium, zinc, and selenium intake among the three groups.

Fruit and vegetable intake

Participants' intake of fruit and vegetable and their Stage of Change classification for both fruit and vegetable intake are reported in Table 1. There was no significant difference among the three groups for vegetable intake or Stage of Change classification for vegetable intake. Young adults had 3.6±1.2 servings of vegetable and their mean stage of vegetable intake was between action stage and maintenance stage. There was no significant difference in mean fruit intake between urban-living low-income group and migration group. The urban-living high-income group had a higher fruit intake than the low-income young adults (P<0.01, 95% CI=0.4 to 1.8). The urban groups scored higher than the migration group for Stage of Change indicating a greater readiness for increasing their fruit intake (P<0.05, 95%CI=0.2 to 1.7). Although urban-living low-income young adults had similarly low fruit

intake as migration group, they scored much higher than migration group in their readiness for having more fruit intake.

Physical activity

Self-reported physical activity records indicated that two-thirds of participants mainly sat or stood at work; one-fourth mostly walked; and 7%, carried out physically demanding or heavy labor. In a usual week, participants had moderate physical activities on 4.0±2.5 days for at least 10 minutes at a time. Moderate physical activities were defined as any physical activities resulting in increased respiration or heart rate, such as, brisk walking, bicycling, vacuuming, and gardening. The mean time participants spent on moderate physical activities was 82 minutes per week (SD=160.0). Participants reported vigorous activities for at least 10 minutes at a time for an average of 2.9 times in a usual week (SD=2.6). Vigorous activities were defined as any activities causing large increases in respiration or heart rates, such as, running, aerobics, and heavy yard work. On an average, participants spent 77 ±131 minutes per week in a usual week on vigorous physical activities. No moderate or vigorous physical activities were reported by 14.0% and 32.6% of the participants in this study.

Food purchasing, preparation, and eating out

There was no significant difference in scores about food purchasing behaviors between urban-living young adults and migrants. Urban-living young adults scored higher on food preparation questions than migrants (3.1±0.5 vs. 2.5±1.1, $P<0.05$, 95%CI=0.1 to 1.2), which means they spent less time on cooking for themselves than migrants. However, the mean score on food preparation questions indicated that young adults spent a limited time helping with food preparation or cooking at home for fewer than half of the meals. Urban-living young adults ate out more times each week than migrants (8.8±8.2 vs.4.5±3.1, $P<0.05$,

95% CI=0.4 to 8.2). There was no difference between the urban high-income young adults and low-income young adults in the scores for food purchasing and food preparation in the home and times eating out per week. Males scored higher on food preparation question than females (3.1±0.8 vs. 2.5±1.0, $P<0.05$, 95% CI = 0.1 to 1.2). Results indicated that females contributed more to food preparation at home than males.

Young adults' attitude toward nutrition transition

Responses of participants to questions investigating their attitudes toward nutrition transition related questions are listed in Table 2. Participants' SES was associated with their responses to each of those five items (Eta = 0.56, 0.50, 0.16, 0.27, and 0.42, respectively). Most urban-living low-income young adults (91%) thought that adding more animal foods indicated an improvement of the diet; but, more than a third of urban-living high-income young adults and more than half migration young adults held the opposite opinion. Nearly three-fourths of urban-living low-income (73%) and migration young adults (77%) indicated a preference for refined grains rather than whole grains, but only 10% of the urban-living high-income group held similar attitudes. These results indicated that urban-living high-income young adults had more positive attitudes toward the consumption of whole grains than the other two groups. Urban-living young adults were more positive toward the importance of regular exercise than migration group. Nearly one-fifth of the migration participants did not think it is important to have regular exercise.

Participants' responses to items investigating their intention toward nutrition transition behaviors are listed in Table 3. Participants' SES was associated with their responses to each of those five items (Eta = 0.38, 0.32, 0.36, 0.35, and 0.20, respectively). Over half of the urban-living low-income young adults (64%) expressed that they would

purchase more animal foods if their economic situation allowed. In contrast, 70% of urban-living high-income young adults and 41% of migration young adults indicated that they would not purchase more animal foods even with more economic resources. Similar percentages of those two groups (70% and 46%) reported that they would not cook dishes with more fat. At the same time, 27% of urban-living low-income young adults said they would use more cooking oil/animal fat. The responses of the three groups to the question about purchasing more processed food were similar to their responses about using more cooking fat, respectively. Most urban-living high-income and migration young adults (70% and 77%) would not to go to fast food restaurants more often. But 27% of urban-living low-income young adults and 18% of migration group said they would like to go to fast food restaurants more often if they could afford it. All three groups were positive about regular exercise when time and economic situation allowed, but 10% of the urban-living high-income group and 9% of migration group answered that they would not participate regular exercise even when their time and economic situation permitted.

Factors correlated to dietary transition and physical activity

The mean dietary transition and physical activity scores for the three subgroups are shown in Table 4. The urban-living high-income group had the highest mean dietary transition score of 3.9, which was significantly higher than the mean dietary transition score 0.2 of the urban-living low-income group and the mean dietary transition score –2.0 of the low-income migration group. Low-income migration group had the lowest dietary transition degree and urban-living high-income group had the highest dietary transition degree. At the same time, the low-income migration group scored the highest for their physical activity.

Participants' Social Economic Status (SES) (1= urban high-income group, 2= urban low-income group, and 3= low-income migration group; β=0.58, P=0.0001), family size (β=-0.47, P=0.0001), educational levels (β=0.41, P=0.001), annual income (β=0.51, P=0.0001), monthly food expenditure (β=0.62, P=0.0001), times of eating out per week (β=0.39, P=0.001), total time of vigorous activity per week (β=-0.38, P=0.002), and intention toward using more cooking oil/fat (β=-0.31, P<0.05) had linear relationship with their dietary transition score (Table 5.).

Participants' physical activity score had linear relationship with their usual activity required at work (1=mostly sit or stand, 2=mostly walk, and 3=heavy labor or physical demanding work; β=0.56, P=0.0001), monthly food expenditure (β=-0.45, P=0.0001), and dietary transition score (β=-0.35, P<0.01) as shown in Table 6.

Discussion

The nutrition transition status of three social economic groups of young adults in China, urban-living high-income, urban-living low-income, and low-income rural-urban migration and their attitudes toward nutrition transition related items were investigated in this study. Among these three subgroups, the rural-urban migration group was a hard-to-reach group and their dietary behaviors had not been reported in other literature.

Previous research has indicated that the trend of nutrition transition in developing countries including China is shifting to a pattern with an increased energy density with greater fat and animal food intake (17,18). This phenomenon was reflected in the diet of urban-living high-income group in this study. The results in this study indicate that the major differences in nutrient intakes between high-income and low-income groups were increased

intakes of fat, carbohydrate, fiber, and cholesterol. The high-income group scored significantly higher on the dietary transition score than either of the low-income groups. Currently the urban-living high-income group had the highest dietary transition scores. However, the urban-living low-income young adults expressed very positive attitudes toward consuming more animal foods and fat, refined grains, processed food, and fast food. The group of urban-living low-income young adults had the least physical activity among the three subgroups investigated. With more economic increases, it is reasonable to believe that they would undergo detrimental nutrition transition without timely intervention. Although the other low-income group of migrant young adults scored the lowest on the dietary transition score, a large percentage of them expressed preferences to consume refined grains and animal foods and fat, which would change dietary patterns to increase chronic disease risk in the future. The low-income migration group with the lowest fruit intake scored the lowest in Stage of Change for readiness to increase fruit intake. Their mean stage of fruit intake was only slightly higher than the preparation stage. These results suggest that rural-urban migrants need nutrition education to promote healthy dietary habit to prevent harmful dietary transition.

This study also explored factors correlated to dietary transition and physical activity levels, which may contribute to the effect of nutrition transition. The migration group had low animal food consumption, however, a large percentage of them had negative attitudes toward consuming more animal foods and a large percentage of them expressed that they would not purchase more animal foods when their economic situation permitted. This finding suggests that there may exist other factors, such as taste preference, related to nutrition transition that were not investigated in current study.

Another finding of this study was that three subgroups had similar nutrition problems including inadequate intakes of vitamin A, calcium, zinc, and selenium. The limitation of this study was that the sample for migration young adults was a convenience sample due to the difficulty of collecting data from rural-urban migration population, thereby limiting the generalizability of results.

Implications for Research and Practice

This study shows that the degree of nutrition transition for dietary changes among young adults is varies in different social economic groups. Urban-living high-income group, urban-living low-income group, and rural-urban migration group had distinct demographic characteristics and specific dietary intake and physical activity patterns. With increased economic development, it is highly possible that urban-living low-income young adults may reach the same pace of nutrition transition of urban-living high-income young adults Interventions to decrease the deleterious effect of westernization on the nutrition transition in China need to meet the identified needs in each social economic group.

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Table 1. Participants' fruit and vegetable intakes and their stages of change of fruit and vegetable intake

Subgroups	Servings of fruit intake (mean±SD)	Servings of vegetable intake (mean±SD)	Stages of change of fruit intake (mean±SD)	Stages of change of vegetable intake (mean±SD)
Urban high-income	2.5±0.8[a]	3.3±1.3	3.0±1.3	3.1±1.3
Urban low-income	1.5±1.5	3.7±1.1	3.3±1.6	3.6±1.4
Rural-urban migration	1.3±0.8	3.6±1.2	2.2±1.0[b]	3.0±1.6

[a] Significant different from low-income young adults (there was no significant difference between urban low-income and rural-urban migration groups so these two groups were combined as a low-income young adult group when fruit intake was compared ($P<0.01$, 95% CI = 0.4 to 1.8)
[b] Significant different from urban groups ($P<0.05$)

Table 2. Young adults' attitude toward nutrition transition related questions

Items	Sub-groups [a]	Percentage (%)						Eta
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Adding more animal foods indicates an improvement of the diet (meat, eggs, poultry, and fish)	1	0	40.0	30.0	30.0	0	0	0.56
	2	0	0	0	45.5	45.5	9.1	
	3	0	59.1	9.1	27.3	4.5	0	
2. I prefer to have refined grains rather than whole grains	1	10.0	30.0	50.0	10.0	0	0	0.50
	2	0	0	9.1	45.5	27.3	18.2	
	3	0	13.6	9.1	54.5	22.7	0	
3. It is important to exercise for 30 to 60 minutes, at least 3 times per week (such as walking, stair climbing, biking, running etc)	1	0	0	10.0	60.0	30.0	0	0.16
	2	0	0	9.1	45.5	27.3	18.2	
	3	0	18.2	13.6	31.8	36.4	0	
4. It is important to eat 3 or more servings of vegetables per day	1	0	10	20	50	20	0	0.27
	2	0	9.1	0	0	63.6	27.3	
	3	0	4.5	9.1	59.1	27.3	0	
5. It is important to eat 2 or more servings of fruits per day	1	0	0	10	70	20	0	0.42
	2	0	0	0	18.2	63.6	18.2	
	3	0	27.3	13.6	31.8	22.7	4.5	

[a] 1= Urban high-income group; 2= Urban low-income group; 3= Low-income rural-urban migration group

Table 3. Young adults' intention toward nutrition transition related behaviors

Items	Sub-groups[a]	Percentage (%)						Eta
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. If economic situation allows, I will buy/have more animal foods (meat, eggs, poultry, and fish)	1	0	70.0	10.0	20.0	0	0	0.38
	2	0	0	18.2	45.5	18.2	18.2	
	3	0	40.9	9.1	31.8	13.6	4.5	
2. If economic situation allows, I will cook dishes with more oil (vegetable oil and/or animal fat)	1	0	70.0	10.0	20.0	0	0	0.32
	2	0	0	72.7	18.2	9.1	0	
	3	0	45.5	9.1	18.2	22.7	4.5	
3. If economic situation allows, I will buy more processed food (like cookies, snacks, french fries, and potato chips etc.)	1	0	80.0	10.0	10.0	0	0	0.36
	2	0	0	54.5	36.4	9.1	0	
	3	4.5	40.9	13.6	31.8	4.5	4.5	
4. If economic situation allows, I will go to fast food restaurants more often	1	0	70.0	20.0	10.0	0	0	0.35
	2	0	9.1	63.6	9.1	18.2	0	
	3	9.1	68.2	0	9.1	9.1	4.5	
5. If economic situation and time allows, I will regularly do exercises for 30 to 60 minutes, at least 3 times per week	1	0	10.0	0	80.0	10.0	0	0.20
	2	0	0	9.1	27.3	36.4	27.3	
	3	0	9.1	18.2	50	22.7	0	

[a] 1= Urban high-income group; 2= Urban low-income group; 3= Low-income rural-urban migration group

Table 4. Subgroups' mean dietary transition score and physical activity score

	Urban-living high-income group	Urban-living low-income group	Low-income migration group
Dietary transition score (mean±SD)	3.9±2.18[a]	0.18±4.02	-1.95±2.94
Physical activity score (mean±SD)	0.5±1.08	0.27±0.65	1.05±1.13[b]

[a] Significant from two low-income groups, P<0.05
[b] Significant from two urban-living groups, P<0.05

Table 5. Linear regression between the dependent variable dietary transition score and each independent variable

Independent Variables	b	Std. Error	β	t	P-value
SES[a]	2.80	0.50	0.58	5.60	0.0001
Education levels	0.90	0.25	0.41	3.57	0.001
Annual income	1.74	0.37	0.51	4.74	0.0001
Monthly food expenditure	0.02	0.003	0.62	6.26	0.0001
Family size	-1.16	0.27	-0.47	-4.26	0.0001
Times of eating out per week	0.25	0.075	0.39	3.33	0.001
Total time of vigorous activity per week	-0.01	0.003	-0.38	-3.29	0.002
Intention toward using more cooking oil/fat	-0.96	0.38	-0.31	-2.54	0.014

[a] 1=low-income rural-urban migration group; 2=urban low-income group; 3=urban high-income group

Table 6. Linear regression between the dependent variable physical activity score and each independent variable

Independent Variables	b	Std. Error	β	t	P-value
Usual activity required at work[a]	0.96	0.18	0.56	5.41	0.0001
Monthly food expenditure	-0.004	-0.001	-0.45	-3.92	0.0001
Dietary transition score	-0.104	0.035	-0.35	-2.96	0.004

[a] 1 = mainly sit or stand; 2 = mostly walk; 3 = physically demanding or heavy labor

CHAPTER 4. IDENTIFYING FACTORS PREDICTING DIETARY TRANSITION BEHAVIORS IN YOUNG ADULTS IN HEBEI, CHINA

A paper to be submitted to the Journal of Nutrition Education and Behavior

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Abstract

Objective: To identify factors predicting dietary transition behaviors in young adults in Hebei, China.

Design: Cross-sectional.

Subjects and settings: Young adults aged 15 to 25 years old (n=206) were randomly selected from four rural villages in Linshou County, a high-income and a low-income community in Shijiazhuang City, and a local pharmaceutical factory employing migrants from rural areas in Shijiazhuang City.

Variables Measured: Demographic information, dietary intake, and 32 items in the predisposing (n=10), enabling (n=10), and reinforcing constructs (n=12) of the PRECEDE-PROCEED model.

Analysis: Factor analysis and multiple regressions. Three constructs with 32 items were treated as three separate models for confirmatory factor analysis to test the construct validity of the questionnaire. Multiple regression analysis was carried out to identify factors predicting dietary transition behaviors.

Results: Confirmatory analysis demonstrated that the questionnaire was tested to have good construct validity. Cronbach's α was calculated for the variables in the three constructs and results ranged from 0.67 to 0.84. All three models expressed good model fit using the $\chi 2/df$

ratio (range = 1.85 to 2.70), root mean square error of approximate (range = 0.07 to 0.09), non-normed fit index (range = 0.92 to 0.97), comparative fit index (range = 0.96 to 0.98), and incremental fit index (range = 0.96 to 0.98) as evaluation tools and all factor loadings were significant ($P<0.01$). When age, gender, and education levels were controlled, beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains ($\beta= -0.20$, $P= 0.005$), taste preference for processed foods ($\beta=0.28$, $P=0.0001$), and cost of fruits and vegetables ($\beta=0.25$, $P=0.0001$) were significant predicting young adults' intention to make dietary changes (R-square=0.31, $P<0.0001$).

Conclusion: The identified factors can help public health educators and researchers explain the development and maintenance of nutrition transition behaviors and serve as theoretical basis for the design of appropriate intervention programs to prevent future harmful health effects associated with the rapid nutrition transition in China.

KEY WORDS: confirmatory factor analysis, dietary transition, predictors, young adults

Introduction

The concept of the nutrition transition is used to describe a sequence of changes in the overall dietary patterns during a certain time period as influenced by economic, social, demographic, and health factors (1). Popkin's model of the nutrition transition describes the sequenced dietary stages associated with changes in social and economic factors: collecting food, famine, receding famine, degenerative disease, and behavioral change (1). With economic development, dietary patterns are changing from the famine stage, through the receding famine stage to the degenerative disease stage in relatively wealthy areas in developing countries. These dietary transition behaviors include increased consumption of

animal foods, fat, and processed food and decreased intake of fruits and vegetables, which lead to a dramatic increase of the incidence of chronic diseases in developing countries. The current dietary transition in developing countries is different from the past experience in the western countries because of its greater velocity and increased concerns for public health (2). The shift in diet that took place in one to two centuries in Western countries is occurring within a few decades in the developing world (2). With rapid dietary transition there is an increased incidence of chronic disease increasing the social burden in the developing world. It is imperative that nutrition researchers and educators design suitable intervention programs to decrease the incidence of chronic diseases. China is undergoing a very rapid economic development with the accompanying transition changes in dietary patterns of Chinese residents (3, 4, and 5). The purpose of this study is to identify the factors affecting dietary transition behaviors among young adults in Hebei province in China as the initial step for designing appropriate intervention programs.

Literature Review

In the nutrition transition model proposed by Barry Popkin (1) there was no agriculture practice before the famine stage. In the famine stage, a region's economy was underdeveloped with basic agriculture practice of raising grain and animals for family use. People had limited variety in their diets and cereals were their major energy and nutrient source. Preventing nutritional deficiency diseases among infants and children is the major concern at that stage.

In the following stage, receding famine, the second agricultural and industrial revolution occurred; diets had fewer starchy products and more fruits, vegetables and animal

protein than in previous stage. Many nutritional deficiencies disappear due to improved nutritional status.

In the degenerative disease phase, the dietary patterns feature more fat, sugar, animal products and less fiber. Development of obesity and chronic health problems are major nutritional problems. This stage is marked by a industrial technology revolution resulting in decreased demand for physical labor. The last section of Popkin's model is the behavioral change pattern of convincing people of the relationship between nutrition and health, and the importance of increasing whole grain, fruit and vegetable intake and decreasing fat intake to decrease chronic disease risk.

With the very rapid economic development in China, the changes in dietary patterns, life style, and disease trends are profound. The data from the China Health and Nutrition Surveys in 1989, 1991, 1993, and 1997 showed that the diet shifted to higher fat content with increased pork, edible oil and egg consumption. The level of leisure activity decreased and the obesity rate increased (3). From 1982 to 1992, the national consumption of cereals and fiber decreased by 12% and 47%; however, meat, egg, and fat/oil consumption increased by 38, 60, and 61% respectively and the average fat energy percentage almost doubled (4). In 1998, two-thirds of adults consuming a diet high in fat (>30% of energy) compared with less than a quarter of the adult population in 1993 (5). From 1991 to 1997, the prevalence of overweight increased from 6.4 to 7.7% and the prevalence of underweight decreased from 14.5 to 13.1% (6). According to the epidemiological studies, the disease pattern in China changed with the shift of the dietary pattern. The proportion of deaths from infectious and deficiency diseases decreased and two-thirds of the total deaths were caused by non-communicable chronic diseases in 1996 (4).

The results of the first national comprehensive survey carried out by the Ministry of Health, Ministry of Science and Technology and National Bureau of Statistics was published in 2004 and the survey found that the prevalence of overweight among Chinese adults was 22.8% and obesity rates were 7.1% in adults and 8.1% in children in cities (7). At these rates, there were about 200 million overweight people and 60 million obese people in China in 2004 (7). An increase in hypertension and diabetes is another finding of this survey: 18.8% and 2.6% of Chinese adults had hypertension and diabetes respectively, which indicated that the population with hypertension and diabetes reached 160 million and 20 million nationwide (7). The problem of hypertension is extremely serious since the total population with hypertension increased by 70 million compared with data from 1991 (7).

The results of some local dietary intake studies (n=150 women, aged 20 to 62) in Beijing, Shanghai, and Nanning in 1997 showed similar patterns of dietary transition. The average macronutrient energy percentages in the diets of these adult women were 12.8% from protein; 38%, fat; and 49.1%, carbohydrate (8). In a 1999 study of 499 adult women in six urban and four rural sites in Jilin Province, the mean percentage of energy from fat was 33.4%, and the mean percentage of energy from protein was 11% (9). The incidence of overweight, obesity, and diet-related chronic diseases increased with rapid changes in dietary patterns. In an epidemiological study of obesity in Shanghai, the prevalence of overweight was 29.5% and the obesity rate was 4.3% in 2776 males and females aged 20 to 94 years (10). More than one third of the participants had abnormal lipid levels and 54.8% had hypertension and 9.8%, type II diabetes mellitus.

Differences between rural and urban dietary intake are an important aspect of the rapid nutrition transition in developing countries. These differences were demonstrated in

total energy intake, energy percentage distribution, and food groups (11, 12). Urban residents had higher total energy intake and much more energy from fat than rural residents, and the results of food frequency questionnaires revealed that urban residents had more variety in their usual diet than rural residents (11, 12). In Sichuan Province, rural residents had limited food variety and they reported eating only rice, vegetable oil, green vegetables, and other vegetables on a daily basis and no other foods on a weekly basis (12). Compared with their rural counterparts, urban respondents reported more food groups in their daily consumption including rice, vegetable oil, green vegetables, lean meat, and wheat, and they also reported other vegetables, fruit, eggs, soybean products, and meat fat on at least a weekly basis (12). Additional local studies found that urban residents consumed a diet higher in fat and meat and lower in carbohydrates and fiber when compared with their rural counterparts in Zhejiang, Shandong, Jilin, and Shanxi Province, indicating that the dietary transition of urban residents is proceeding at a greater rate than rural residents (9, 13, 14, 15). However, Popkin has pointed out that longitudinal studies comparing velocity of nutrition transition in rural and urban areas have not been conducted nor have the factors that contribute to the differences in rural and urban dietary intake been identified (1). The dilemma of understanding rural-urban differences and dealing with the public health problems associated with the huge rural-urban migration waves in China show the need for research to identify factors influencing the nutrition transition process.

In previous research conducted in China to study the increase in fat intake, the factors identified were income, food price and food availability, influence and contribution from the modern food industry, and the mass media (11). Since nutrition transition behaviors are essentially health-related behavior changes, some multidimensional variables previously

identified include personal factors, environmental factors, and rewards associated with emotions and physical expectations (16).

In studies of Chinese Americans and Chinese Canadians, concerns about self-image and personal health were two factors that explained motivation toward a low-fat diet with increased fruit and vegetable intake (17). Focus group studies identified beliefs about the relationship between diet and health as another personal factor affecting dietary intake in low-income mothers of preschool children (18). In another recent study of correlates of fat intake among low income African Americans, additional personal factors affecting dietary intake were found to be education and knowledge level (19). In that study, annual income together with food availability and food price were important environmental factors affecting dietary fat intake (19). Oral sensation including taste and texture of food has been shown to influence dietary choice as a reward factor (20), and the emotional states associated with food intake are involved in the interaction process between central satiety signals and final reward responses to food (21).

No previous studies using a theoretical model to study factors influencing dietary transition behaviors in China were located in the literature; therefore, this theory-guided study was conducted to determine factors predicting dietary transition behaviors as a basis for designing suitable intervention programs in the future.

Description of Theoretical Framework

The PRECEDE-PROCEED model was developed by Green and Kreuter to identify factors influencing health-related behaviors and to design and evaluate health promotion programs (22). This model demonstrated that health-related behaviors are voluntary so that

successful intervention programs can realize health-related behavior changes by influencing the precursors to behaviors including predisposing factors, enabling factors, and reinforcing factors to (22). Predisposing factors include knowledge, attitudes, cultural beliefs, readiness to change, health concerns, and the perceived health benefits of a behavior (22). Enabling factors that influence whether motivation will become usual behaviors include food availability, food accessibility, cost of food, and supportive policies (22). Reinforcing factors are the continuing rewards learners experience after they adopt a behavior, which encourage the continuation of the behavior (22). Oral sensation and taste, the emotional experience with food intake, social support, praise, reassurance, and symptom relief are all reinforcing factors (16, 22).

The advantage of the PRECEDE-PROCEED model is that it can incorporate existing theories and constructs into a comprehensive system to describe health-related behavior changes and use existing theories to guide the examination of factors in the predisposing, enabling, and reinforcing constructs. In this study, components in the Theory of Reasoned Action (23) and Social Learning Theory (SLT) were selected as factors in the predisposing, enabling, and reinforcing constructs based on the literature review and results of the pilot study to construct a comprehensive framework based on the PRECEDE-PROCEED model (24). The predisposing construct included beliefs about diet and health, health concerns, and the intention to eat foods in certain food groups. Fishbein and Ajzen (23) proposed the Theory of Reasoned Action to establish a relationship among Beliefs, Attitudes, Intentions, and Behaviors. That theory purports that beliefs about an object held by a person determines that person's attitudes toward the given object so that beliefs reflect a person's attitude (25). In developing this theory they found that knowing a person's intention to perform or not to

perform a specific behavior can predict that person's behavior (23). Therefore, items were included to measure beliefs in diet and health and intentions toward nutrition transition behaviors in the predisposing construct in our framework. And based on Fishbein and Ajzen's theory, average scores on items measuring intentions toward dietary transition behaviors were used as indirect measurements for young adults' potential dietary behavior changes in this study. The factor health concern was included in this construct since the SLT has demonstrated that health concerns affect health related behaviors (24) and this factor was selected in the predisposing construct in the PRECEDE-PROCEED model by Green and Kreuter (22).

Social Cognitive Theory was expanded from SLT, and explains how people acquire and maintain certain behavioral patterns, in which environment factors affect behavior change (26) and food availability and accessibility and cost are environmental factors affecting food consumption. Additionally, in a recent study using the PRECEDE-PROCEED model to explain fat intake behaviors of low-income mothers, food consumption, food availability, and food cost were included for the enabling construct and performed good model fit (16). Therefore, food availability, accessibility, and cost were measured in the enabling construct in this study.

The reinforcing construct consists of social support and taste preference. Social support and subjective norms have been measured in several theoretical models to determine their influence on behaviors (22, 23). The theory of reasoned action states that performance of a given behavior by an individual is affected by subjective norms, which include the influence of the social environment and perceptions about what other people think the person should do (23). Social support was measured by Green and Kreuter as part of the reinforcing

construct to measure the continuing rewards received by behavior learners (22). In a research study studying food consumption behaviors in Chinese immigrants to North America, social support, including the family members' dietary preferences and their advice concerning a particular food group affected food consumption behaviors in Chinese immigrants (27). Therefore, the factor social support from family members was included in the reinforcing construct to study its contribution to the adoption or non-adoption of the nutrition transition behaviors. According to SLT, outcomes of behavior changes are classified as having immediate benefits or long-term benefits. The perceived good taste of food is an immediate benefit reinforcing the repeat intake of a particular food (26). Therefore, taste was included as a factor influencing the persistence of a behavior change in the reinforcing construct.

Description of Methods

Subjects and settings

This study was approved by the Institutional Review Board (IRB) at Iowa State University (Appendix 1). A sample of 206 young adults aged 15 to 25 years old were selected from four socioeconomic groups in Hebei Province, China: rural residents, urban-born high-income group, urban-born low-income group, and rural-migration group. The rural residents (n=56) were randomly selected from 4 villages in Lingshou County in which 190 young adults ages 15-24 were living. The high-income young adults (n=51) were randomly selected from an urban newly-built high-income community in Shijiazhuang city with 420 residents. The total number of young adults aged 18-24 years old in that community was 200. Similarly, the low-income young adults (n=50) were randomly selected from a low-income community in Shijiazhuang having 200 residents. There were 170 young adults aged 18-24

years old in that community. The rural-migration group (n=49) was randomly selected from a local pharmaceutical factory with 120 rural-migration workers aged 17-25 years old.

Procedures and measures

Five interns majoring in public health at Hebei Medical University were recruited and trained to collect data from the participants. During face-to-face interviews, these interns measured blood pressure, pulse, height and weight and asked participants to complete the survey instrument which included demographic characteristics, a chronic disease risk factor survey, a fruit and vegetable frequency questionnaire, a food frequency questionnaire, a nutrition transition questionnaire, and a 24-h food recall with the help of our trained interns. All survey materials were translated into Chinese and back translated into English and reviewed by the translator assigned by the IRB at Iowa State University to ensure their consistency. During the development process of the questionnaires, peer reviewers (n=7) with experience with similar populations and/or questionnaire development reviewed the instrument for clarity and content validity. Some items were removed and other items were added according to the review. All the survey materials were tested in a pilot study (n=43) in a similar study setting. Questions asking the availability of specific food groups and participants' perceived affordability of those food groups were added into the survey based on the results of the pilot test.

Data collected with the survey instruments included participants' demographic information, personal and family medical history, physical activity, dietary intake, food and diet related behaviors including food purchasing and preparation and eating out, tobacco use, and alcohol consumption. The nutrition transition portion of the survey instrument included 32 items within the seven factors mentioned in the theoretical framework to measure

predisposing, enabling, and reinforcing constructs of the PRECEDE-PROCEED model. The items in the nutrition transition questionnaire had six response categories: "Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree", and "Do not know" and they scored 0 to 5 respectively. Score 5 was defined as missing value during data analysis process.

The predisposing construct consists of four factors: two, measuring beliefs (beliefs^1 and beliefs^2), health concerns, and intention. The factor, beliefs^1, included 3 items measuring participants' beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains. The factor, beliefs2, included 2 items measuring the relationship between chronic diseases and having 3 or more vegetables and 2 or more fruits every day. There were 2 items asking participants' concern about their personal health in the factor health concerns. The intention factor included 3 items assessing participants' willingness to buy/eat more animal foods, vegetable oil and/or animal fat, and processed food. To measure the enabling construct, the factor food availability and accessibility (4 items) and the factor food cost^1 (4 items) and food cost^2 (2 items) were chosen to ask the participants the availability of animal foods, fruits and vegetables, and processed food and their perceptions about the price of common food groups. Food cost^1 measured the food cost of animal foods, oil, and processed foods. Food cost^2 measured the food cost of fruits and vegetables. The reinforcing construct included 5 factors and they were social support for unprocessed food (3 items), social support for processed food (2 items), taste preference for animal foods, oil, and refined grains (3 items), taste preference for fruits and vegetables (2 items), and taste preference for processed foods (2 items). The social support factors

measured family members' food preferences and the consequent influence on the family dietary intake.

Statistical analysis

Data were analyzed using SPSS 12.0 (SPSS Inc., Chicago, IL) and LISREL 8.5 (Scientific Software International, Chicago, IL). Cronbach's α was calculated for each factor in the three constructs to evaluate the reliability of the survey instrument. For the factor analysis, the three constructs were treated as three separated models. To test the construct validity of the questionnaire, confirmatory factor analysis (CFA) was carried out to determine if the number of factors and the loadings of measured indicators (items) on them conform to what is expected according to pre-established theories. In a confirmatory factor analysis the theory was tested by examining the consistency of actual data with the hypothesized relationships between all of the unobserved latent factors and the observed measured variables. Items were selected based on the Theory of Reasoned Action and the SLT to build the three constructs in the PRECEDE-PROCEED model. Indicators were specified to load on the factors described above in Procedures and Measures and factors were allowed to correlate. The statistical tests used to evaluate the model fit were chi-square to df ratio (χ^2/df) ≤3, Bentler Bonett Index or Normed Fit Index (NFI) >0.9, Tucker Lewis Index or Non-normed Fit Index (NNFI) >0.9, Comparative Fit Index (CFI) >0.9, Root Mean Square Error of Approximation (RMSEA) ≤0.1, and incremental fit index (IFI) >0.9. To evaluate discriminant validity, the relationship between indicators from different factors and the intercorrelations between each two factors in a model were calculated.

Multiple regression analyses were carried out to test the importance of the eleven factors in the three constructs of the PRECEDE-PROCEED model predicting young adults'

dietary transition behaviors to whether some factors are more important than other factors for predicting the dietary changes made by young adults. A regression model was constructed with those eleven factors as independent variables and with intention to make dietary changes as the dependent variable. Intention to make dietary changes was considered as an indirect measurement of their potential dietary behavior changes. When several factors were found to be more important than other factors for predicting the intention of young adults to make dietary changes, another multiple regression model was constructed and tested to see if those factors would remain significant when age, gender, and education levels are controlled. The significance level was set at α=0.05. To assess multivariate multicollinearity, the variance inflation factor (VIF) was measured.

Description of Results

Demographic characteristics

Of 206 participants, 52% were male and 48%, female. The mean age of the sample was 20.9 years (SD=3.2). Approximately one-third of participants received an education beyond a college degree, 12%, were college graduates, 2% graduated from a technical school, 14% had a high-school education, 33% had a junior-high school education, and 5% of them had an education level of primary school or less. More than half of the participants (60%) were employed in comparatively stable positions; 22% of them were students and 18.9% were temporarily employed or unemployed. The majority of the participants were single (88%) and only 12% were married or living as married. The average number of people per household was 3.8 (SD=1.3). On average there were 3.1 adults (SD=1.3) and 0.6child (SD=.8) per household; 33% were living with one child in the family; 10% were living with

two children and 2% were living with three or more children. The mean annual income was 7822 Yuan (SD=9160 Yuan) and the mean food expenditure per month was 233.8 Yuan (SD=257.0) (100 Yuan equals to about 12.2 US dollars). Approximately one-third of participants reported smoking; and 19% stated they smoked every day. The average Body Mass Index of the participants was 20.9 (SD=2.6). The percentages of participants who had been told by a physician that they had diabetes, CVD, hyperlipidemia, stoke, digestive system diseases, and tuberculosis were 1%, 6.8%, 1.9%, 2.4%, and 1.5%, respectively.

Dietary intake

The mean total energy intake of male and female participants were 2273.7±718.0 kcal and 1750.1±580.8 kcal, respectively. For both males and females the average percentage of energy from carbohydrate was 66.3% (SD=11.8%). The average percentage of energy from protein was 13.0% (SD=2.6%) and the percentage of energy from fat was 22.1% (SD=9.7). The high-income urban group had significantly higher intake of dietary protein ($P<0.01$, 95%CI= 0.5 to 2.5%), fat ($P<0.0001$, 95%CI= 6.2 to 11.2%) and cholesterol ($P<0.01$, 95%CI= 42 to 261 mg) and lower intakes of carbohydrate ($P<0.0001$, 95% CI=7.4 to 13.7%) and fiber ($P<0.05$, 95%CI=0.2 to 2.8g) than the three low-income groups. The actual dietary intake of macronutrients, fiber, and cholesterol of the four SES groups are listed in Table 1.

Reliability and validity of the questionnaire

Cronbach's α for each factor in the three constructs was ≥ .67 (Table 2). In the CFA the four-factor model for the predisposing construct expressed good model fit and the parameters of measures of fit were: χ^2/df =1.85, RMSEA= .07, NFI= .92, NNFI= .94, CFI= .96, IFI= .96 (Figure 1a.). The results of the CFA identified a congeneric model with 3

factors including food availability and accessibility, cost of animal foods, oil, and processed foods, and cost of fruits and vegetables which had good model fit using the parameters of measures of fit as: χ^2/df =2.20, RMSEA= .08, NFI= .94, NNFI= .95, CFI= .97, IFI= .97 (Figure 1b.). The CFA conducted for the model of the reinforcing construct with five factors including social support for unprocessed food, social support for processed food, taste preference for animal foods, oil, and refined grains, taste preference for fruits and vegetables, and taste preference for processed foods showed an acceptable model fit and the parameters were: χ^2/df =2.70, RMSEA= .09, NFI= .97, NNFI= .97, CFI= .98, IFI= .98 (Figure 1c.). All factor loadings of the three congeneric models were significant (P<0.01). These results showed that the questionnaire had good construct validity. The correlation coeffecients between indicators from a factor and other indicators from different factors in each model were low indicating little relationship between indicators from different factors, which is evidence of discriminant validity. The other evidence supporting the discriminant validity was that the intercorrelation coeffecients between any 2 factors in every model was less than .85.

Factors predicting dietary transition behaviors

Among the eleven factors in the three constructs of the PRECEDE-PROCEED model, four factors were more important predicting Chinese young adults' intention to make dietary changes than the other seven factors (Table 3. R-square=0.35, P<0.0001). These four factors were beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains (β= -0.24, P<0.0001), taste preference for processed foods (β=0.28, P<0.0001), cost of fruits and vegetables (β=0.22, P=0.002), and taste preference for fruits and vegetables (β= -0.15, P=0.05). Multicollinearity was not a problem because the

values of the VIF for each of the independent factors were less than 2.0. Table 4 shows the results of the multiple regression analysis of those four factors controlling for age, gender, and education levels. When age, gender, and education levels were controlled, three of those four factors, beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains (β= -0.20, P= 0.005), taste preference for processed foods (β=0.28, P=0.0001), and cost of fruits and vegetables (β=0.25, P=0.0001) remained significant for predicting young adults' intention to make dietary changes. Education level was another important factor predicting young adults' intention to make dietary changes (β= -0.17, P=0.05). The VIF values were smaller than 2.0, which indicating that multicollinearity was low in that regression model.

Further Discussion

This study is an initial trial of use of the PRECEDE-PROCEED model to study factors predicting the dietary transition behaviors in a developing country such as China. The advantage of the PRECEDE-PROCEED model is that it can incorporate the existing theories and supply an overall conceptual framework to understand health-related behaviors. This study applied previously existing theories including the Theory of Reasoned Action and the Social Learning Theory to guide the factor selection to build up theoretical models for the three constructs in the PRECEDE-PROCEED model and utilized confirmatory factor analysis to evaluate whether the collected data are consistent with the hypothesized factor models and acquired good model fit. The three models for the predisposing, enabling, and reinforcing constructs are conceptual frameworks to better understand factors influencing the occurrence and the persistence of dietary transition behaviors.

The major characteristics of nutrition transition behaviors are increased dietary intake of animal foods, oil, processed grains and processed foods and decreased intake of fruits and vegetables. Beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains, taste preference for processed foods, and cost of fruits and vegetables were identified important predicting Chinese young adults' dietary transition behaviors controlling for age, gender, and educational levels. Among these identified factors, people's beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains is a modifiable factor and could be changed by nutritional education. Therefore, this result advocates the possibility to alter the adverse trends of dietary transition by massive nutritional education to advertise and teach the public healthy dietary habits, which is extremely scarce in China.

The identified factors and their roles in the development and maintenance of the dietary transition behaviors can help explain the existing differences in the process of dietary transition between different SES groups. Although longitudinal studies are still needed to verify the differences in the velocity of the nutrition transition happening in different SES groups, numerous studies including this study observed differences in dietary intakes between different SES groups. However, special caution is needed to utilize the results of those predicting factors from this study because of the fact that the study sample was selected from four different SES groups and those predicting factors were identified by building up regression models using data combining from all the groups. Cost of foods was measured as people's perceived expensiveness of those foods in this study. The factors including beliefs about diet and health and perceived expensiveness of fruits and vegetables may explain the development of those differences between different SES groups from multiple aspects.

Furthermore, the taste factor could be involved in the development of differences because the formed dietary habit influenced by foods that a person was exposed to when he/she was young may affect a person's taste preference and his/her future food selection (28).

This study was carried out in Hebei Province, China and its results from the random sample can only reflect the current situation in that area and cannot be generalized to other areas. Four More local studies are needed in different developing countries to further understand the nutrition transition happening in those countries.

Implications for Researchers and Educators

This study identified several factors predicting dietary transition behaviors, which can serve as a theoretical guide for further intervention and research programs. The identified factor, beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains, is a modifiable factor that could be improved directly by nutrition education to prevent adverse effects of dietary transition. The identification of those factors supports the application of massive public nutritional education to broadcast the nutrition- and health- related messages. Based on these results, researchers and educators can now conduct studies to evaluate people's nutrition knowledge levels and design suitable intervention programs. This study also identified the importance of governmental food policies and support and its role in minimizing the dietary differences between different SES groups in that food availability and accessibility and food price can be partially adjusted by governmental efforts.

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Table 1. Dietary intakes of macronutrients, fiber, and cholesterol of four SES groups (n=206)

	Urban high-income (Mean±SD)	Urban low-income (Mean±SD)	Rural-urban migration (Mean±SD)	Rural (Mean±SD)
Carbohydrate (%)	58.4±9.3[a]	66.2±10.7	67.1±12.7	73.1±9.4
Protein (%)	14.2±3.2[a]	12.9±2.2	12.9±2.2	11.7±1.3
Fat (%)	28.7±7.2[a]	22.8±9.0	21.0±10.1	16.6±8.2
Fiber (g)	10.1±4.0[a]	10.8±4.3	11.6±4.7	12.3±4.3
Cholesterol (mg)	495.3±327.4[a]	357.3±293.2	357.3±293.2	209.8±306.7

[a.] Significantly different from other three SES groups ($P<0.05$).

Table 2. Reliability of nutrition transition associated factors within Predisposing, Enabling, and Reinforcing constructs of the PRECEDE-PROCEED model among young adults in Hebei, China

Construct	Factor[a]	N[b]	Cronbach α
Predisposing	Beliefs[1]	3	0.67
	Beliefs[2]	2	0.68
	Health concerns	2	0.69
	Intention	3	0.67
Enabling	Food availability	4	0.82
	Cost[1]	4	0.76
	Cost[2]	2	0.86
Reinforcing	Social support for unprocessed food	3	0.70
	Social support for processed food	2	0.74
	Taste[1]	3	0.68
	Taste[2]	2	0.83
	Taste[3]	2	0.80

[a] Beliefs[1] = beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains; Beliefs[2] = beliefs in the relationship between chronic diseases and having 3 or more vegetables and 2 or more fruits every day; Cost[1] = cost of animal foods, oil, and processed foods; Cost[2] = cost of fruits and vegetables; Taste[1] = taste preference for animal foods, oil, and refined grains; Taste[2] = taste preference for fruits and vegetables; Taste[3] = taste preference for processed foods.

[b] N=number of items in the questionnaire

Table 3. Results of the multiple regression model using eleven predictors in the PRECEDE-PROCEED model to predict Chinese young adults' intention to have dietary transition behaviors (R-square=0.35, P<0.0001)

Predictors[a] (n=206)	b	Std. Error	β	t	P-value
Beliefs[1]	-0.27	0.07	-0.24	-3.63	<0.0001
Beliefs[2]	-0.09	0.08	-0.09	-1.15	0.25
Health concerns	0.02	0.07	0.02	0.28	0.78
Food availability	-0.05	0.07	-0.05	-0.69	0.49
Cost[1]	-0.01	0.02	-0.03	-0.41	0.67
Cost[2]	0.20	0.06	0.22	3.19	0.002
Social support for unprocessed food	0.05	0.07	0.06	0.75	0.45
Social support for processed food	0.05	0.07	0.07	0.84	0.40
Taste[1]	0.05	0.02	0.13	1.94	0.054
Taste[2]	-0.13	0.07	-0.15	-1.98	0.05
Taste[3]	0.24	0.06	0.28	3.82	<0.0001

[a] Beliefs[1] = beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains; Beliefs[2] = beliefs in the relationship between chronic diseases and having 3 or more vegetables and 2 or more fruits every day; Cost[1] = cost of animal foods, oil, and processed foods; Cost[2] = cost of fruits and vegetables; Taste[1] = taste preference for animal foods, oil, and refined grains; Taste[2] = taste preference for fruits and vegetables; Taste[3] = taste preference for processed foods.

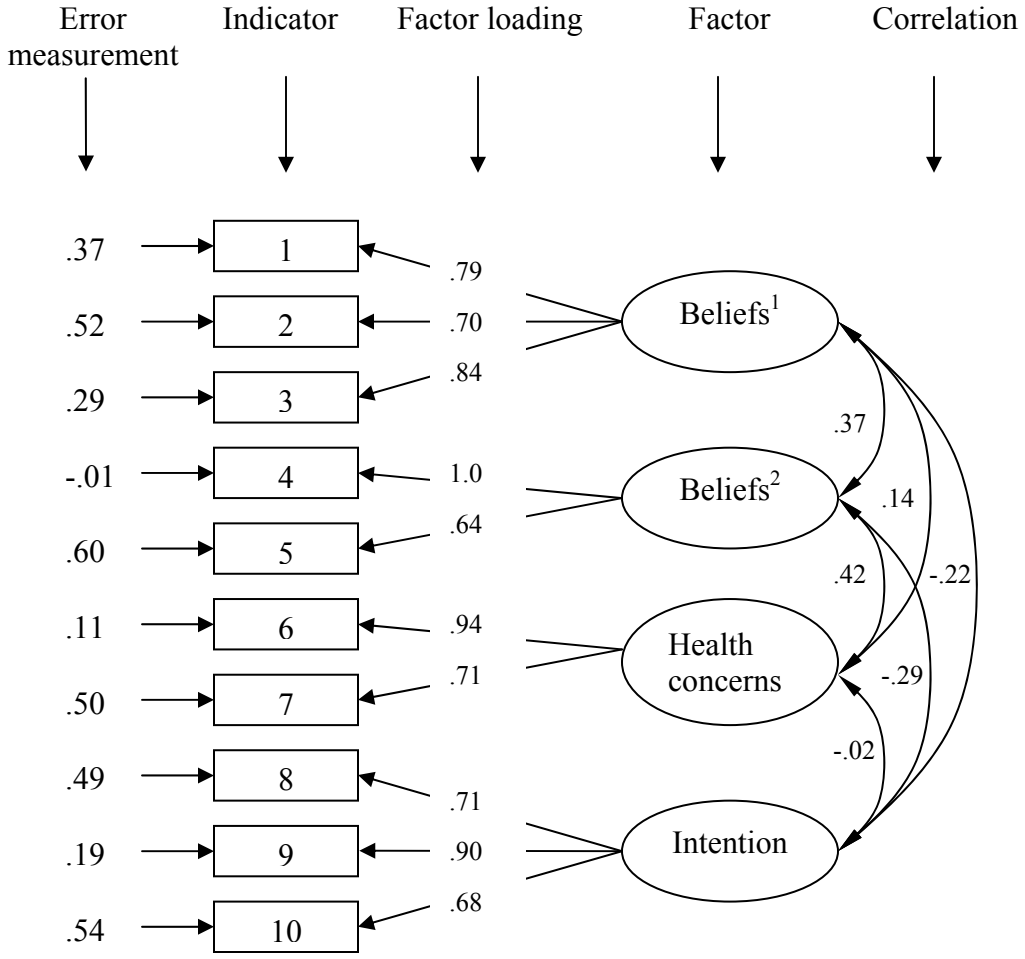
Table 4. Results of the multiple regression model predicting Chinese young adults' intention to have dietary transition behaviors controlling for age, gender, and education levels (R-square=0.31, P<0.0001)

Predictors[a] (n=206)	b	Std. Error	β	t	P-value
Belief[1]	-0.22	0.08	-0.20	-2.84	0.005
Taste[3]	0.24	0.06	0.28	3.97	0.0001
Cost[2]	0.22	0.06	0.25	3.65	0.0001
Taste[2]	-0.12	0.06	-0.13	-1.92	0.057
Age	0.02	0.07	0.02	0.23	0.816
Gender	-0.04	0.10	-0.02	-0.36	0.723
Education	-0.07	0.04	-0.17	-1.97	0.050

[a] Beliefs[1] = beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains; Taste[3] = taste preference for processed foods; Cost[2] = cost of fruits and vegetables; Taste[2] = taste preference for fruits and vegetables.

Figure 1. Models for predisposing, enabling, and reinforcing constructs for nutrition transition behaviors among young adults in Hebei, China.

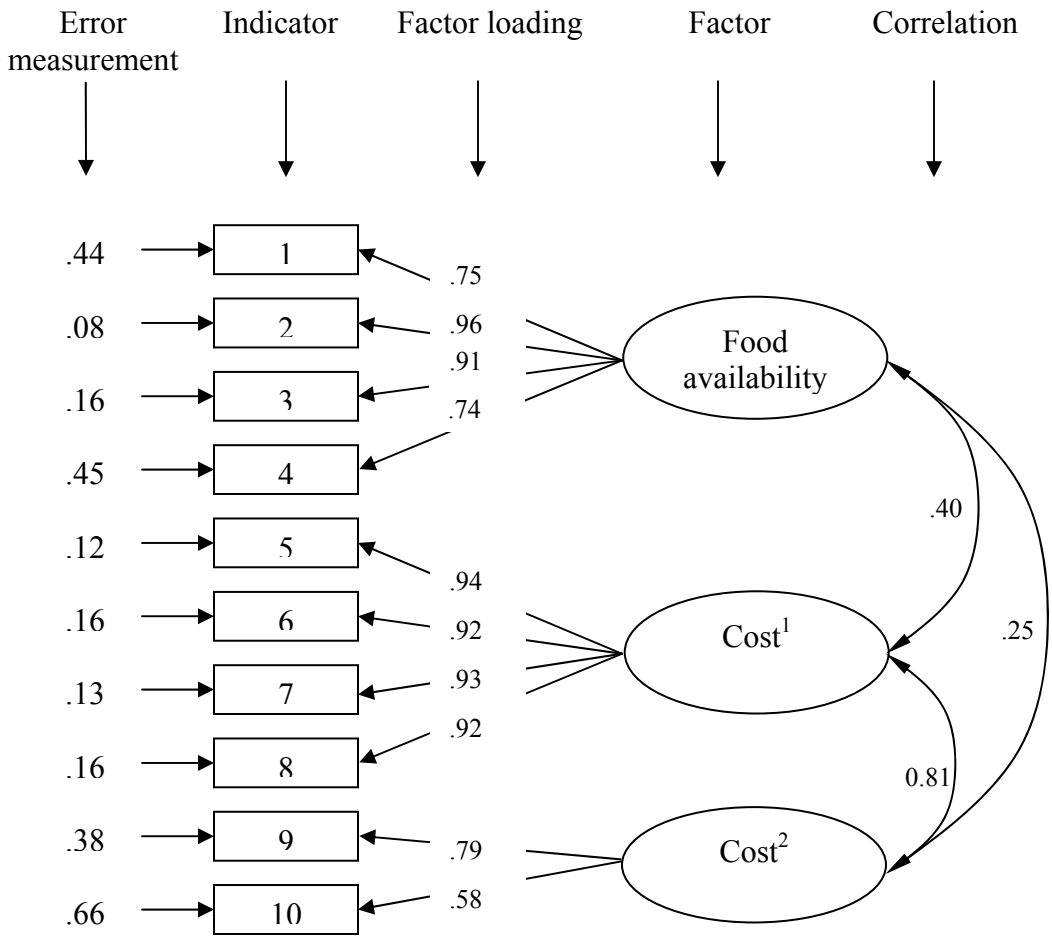
a. The Predisposing Construct
χ^2/df =1.85, RMSEA= .07, NFI= .92, NNFI= .94, CFI= .96, IFI= .96



Beliefs[1] = beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains; Beliefs[2] = beliefs in the relationship between chronic diseases and having 3 or more vegetables and 2 or more fruits every day; Cost[1] = cost of animal foods, oil, and processed foods; Cost[2] = cost of fruits and vegetables; Social support[1] = social support for unprocessed food; Social support[2] = social support for processed food; Taste[1] = taste preference for animal foods, oil, and refined grains; Taste[2] = taste preference for fruits and vegetables; Taste[3] = taste preference for processed foods.

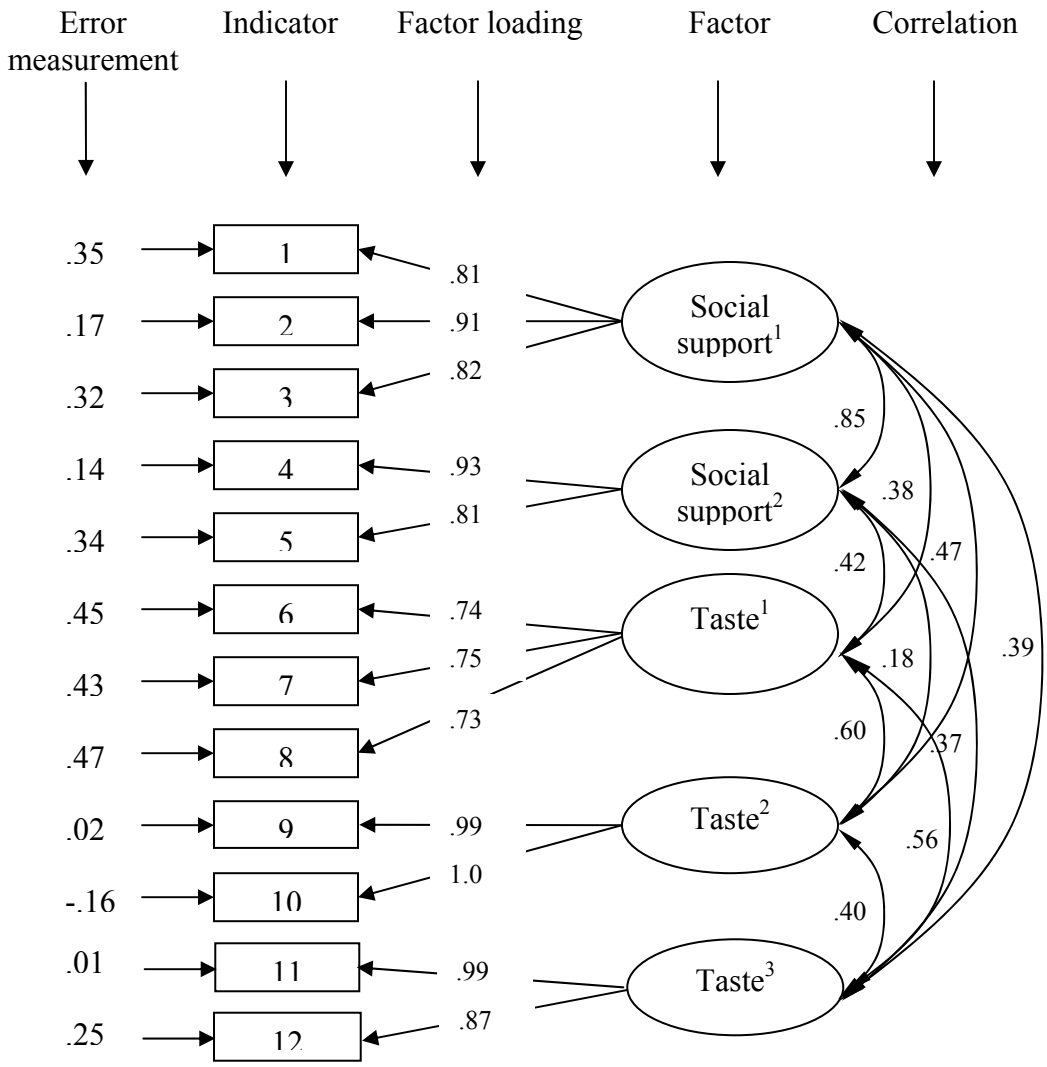
b. The Enabling Construct

χ^2/df =2.20, RMSEA= .08, NFI= .94, NNFI= .95, CFI= .97, IFI= .97



c. The Reinforcing Construct

χ^2/df =2.70, RMSEA= .09, NFI= .97, NNFI= .97, CFI= .98, IFI= .98



CHAPTER 5. EFFECTS OF URBAN RESIDENCE ON DIETARY INTAKE AND DIETARY TRANSITION IN YOUNG ADULTS IN HEBEI, CHINA

A paper to be submitted to the Journal of Nutrition Education and Behavior

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Abstract

Objective: To study the effects of urban residence on dietary intake and diet-related factors in young adults in Hebei Province, China

Design: Cross-sectional.

Participants: Randomly selected young adults (n=49) migrating from rural areas to the urban study site, Shijiazhuang and their rural counterparts (n=56) from the rural study site, Lingshou County.

Variables measured: Demographic characteristics, dietary intake, food purchasing and preparation behaviors, eating-out practice, diet and health related attitudes and behaviors, food preferences, social support for consumption of certain food groups, and physical activity.

Analysis: Frequencies, T-test, and multiple linear regressions.

Results: The percent of energy from protein and fat and intake of dietary cholesterol were significantly higher in the diets of the young adults who migrated. The migration group had higher incomes, greater food expenditure, and a higher BMI than their rural counterparts ($P<0.05$). Eating out was much more frequent in the migration group ($P<0.0001$, 95% CI = 5 to 10 times/wk). When age, gender, and education levels were controlled, urban residence was significantly associated with greater protein and vegetable intake, belief in the

importance of consuming the recommended amount of fruits and vegetables per day, intentions to consume more animal foods and oil, perceived social support from family members on having fruits and vegetables, and taste preferences for animal foods, fruits, and vegetables.

Conclusions and implications: This study revealed that migrating from rural to urban impacted dietary intake and a series of factors related to dietary transition. The results of this study suggest that the effects of urban residence on food consumption resulted from the interactions of increased income and food expenditure with eating out more frequently, changes in food preferences, and more social support.

KEY WORDS: dietary transition, urban effects, rural-urban migration, young adults

Introduction

Urbanization is a continuous worldwide trend, as people move into cities for more employment opportunities and better living conditions. There were 4.8 billion people living in cities in the developing world in 2000 (1). The urban growth rate of developing regions reached 3.0 per cent per year in the recent five-year period of 1995 to 2000, and this rate is projected to remain high in the urban areas of less developed regions, averaging 2.4 per cent per year during the period of 2000-2030 (1). With this growth rate, almost all of the population increase projected during this time period will be absorbed by the urban areas (1). Within 25 years, the United Nations is projecting that 2 billion more people will be found in urban areas (1).

The determinants of migration are the location of employment, which is determined by industrialization, agricultural changes, and the development of advanced transportation

and communication networks. In developing countries, surplus rural laborers trigger migration to urban employment centers. A reduction in mortality rates in China after World War II, while fertility remained high, led to an unprecedented growth in the rural population. Then the development of technology decreased the labor required for farming. Because the rural areas could not absorb this surplus population, urbanization and city growth both proceeded rapidly. Economic imbalance between locations is a major cause of migration (2). On the other hand, urbanization can be considered as a movement towards increased productivity and economic efficiency.

Urbanization has a remarkable impact on diet in the developing world. Some local studies in developing countries showed significant differences between the dietary intake of rural and urban residents (3, 4, and 5). Generally, urban residents had lower total energy, carbohydrate, and fiber intake, but higher protein and fat intake (3, 4, and 5). Dietary changes associated with urbanization include increased intake of fat, especially saturated fat and trans fatty acids, sugar, and other refined carbohydrates. The type of dietary changes in dietary transition needs special attention because of its established relationship to increased risk for chronic diseases (6). In 2004, the 192 Member States of the World Health Organization called for action on the diet transition to redirect it to a healthy one.

However, it is not clearly understood why urban residence is associated with shifts in the overall dietary patterns in developing countries (7). It is believed that higher income and lower food prices for processed foods and vegetable oils affect the consumption of fat and protein intake of urban residents. Higher income favors greater dietary variety including the more expensive food categories, such as animal foods. Globalization promotes lower food prices and greatly increases the availability of highly processed foods and vegetable oil to

developing countries. Although it is easy to understand the effects of income and food prices on the dietary patterns of urban residents, previous results demonstrated that living in urban areas affected the consumption of certain food groups when income and food prices were controlled (8). This research finding suggests the existence of unknown factors contributing to the effects of urban residence on dietary changes and a possible cooperative relationship among all the factors affecting the dietary intake of urban residents. To identify possible factors and to better understand the interactions among those factors, a survey was designed to study the effects of urban residence on young adults' dietary intake and diet-related psycho-behavioral factors in Hebei, China by selecting rural-urban migration young adults and their rural counterparts as study participants. No other reports of studies investigating rural-urban migrants' nutrition-related behaviors and attitudes in China were found in the literature.

Description of Study

Subjects and study sites

This study was approved by the Institutional Review Board (IRB) at Iowa State University (Appendix 1). Our urban study site, Shijiazhuang, is the capital of Hebei province, China with an urban population of 1.9 million. The rural study site, Lingshou County, is a neighboring county of Shijiazhuang City with a population of 0.3 million and 51 villages. Random selection of 49 rural-urban migration young adults aged 17 to 25 years old working for a local pharmaceutical factory in Shijiazhuang city was made from factory employee list and using computer generated random numbers. There were 120 rural-urban migration workers between the ages of 17-25 in that factory. Their rural counterparts (n=56) were

randomly selected from 4 villages in Lingshou County in which 190 young adults ages 15-24 were living.

Procedures

Five interns majoring in public health at Hebei Medical University were recruited and trained to help carry out the survey. During in-person interviews, the trained interns measured young adults' blood pressure, pulse, height and weight. Participants completed survey instruments including chronic disease risk factor survey, a fruit and vegetable frequency questionnaire, a food frequency questionnaire, a Staging Algorithm for fruit and vegetable intakes, a nutrition transition questionnaire, and a 24-h food recall with the help of our trained interns. A validated Staging Algorithm for fruit and vegetable intakes based on the Transtheoretical Model (TTM) was adapted from previous research (9, 10). The TTM is a model that has been used to describe health-related behaviors and consists of these components: the stages of change, decisional balance, self-efficacy, and processes of change (10). The stage of change portion of the TTM classifies readiness to change into five stages: Precontemplation, Contemplation, Preparation, Action, and Maintenance. All survey materials were translated into Chinese and back translated into English to ensure their consistency. During the development process of the questionnaires, peer reviewers (n=7) with experience working with similar populations and/or questionnaire development reviewed the instrument for clarity and content validity. Some items were removed and some items were added according to the review. All the survey materials were tested in a pilot study (n=43) conducted in similar study settings. Standard bowls, plates, cups, and food models were shown to the participants to help them visualize serving sizes and more accurately estimate portion sizes. Nutrient analysis of diet intake data were calculated using

Chinese nutrition database software Nutrition Calculator V1.6 (Chinese CDC Institute of Nutrition and Food Safety and Beijing Feihua Communication and Technology LLC, Beijing,China). This study investigated participants' demographic information, medical history and family history, physical activity, dietary intake, food and diet-related behaviors including food purchasing and preparation and eating out, food preference, social support, tobacco use, and alcohol consumption.

Statistical analysis

Data were analyzed by using SPSS 12.0 for Windows (SPSS, SPSS Inc., Chicago, IL). Statistical significance level was set at α=0.05. Readiness for increasing fruit and vegetable intake or maintaining ideal intake was measured by the Staging Algorithm for fruit and vegetable intake and the five stages of Precontemplation, Contemplation, Preparation, Action, and Maintenance were scored 0 to 4, respectively. The response categories for the items asking participants' role in the family's food purchasing and food preparation were "almost always", "about ½ time", "seldom", and "never" and scored 1 to 4, respectively. There were four response categories for the two items asking participants' awareness of any nutrition material in the media and if they learned/read any information about nutrition and a healthy diet, "Never", "A little", "Some", and "A lot", and these were scored 1 to 4. Items for diet-related attitudes, intentions, taste preferences, and social support for eating specific food groups had six response categories: "Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree", and "Do not know" and they scored 0 to 5 respectively. Responses in category "Do not know" scored 5 and were treated as missing values. T-test was calculated to detect differences between means of variables for the migration and the rural groups. If a difference was found, the 95% confidence interval was

calculated. Each significant difference found between the means of the two groups was selected as a dependent variable to build a multiple linear regression model to study if residence is associated with that dependent variable when age, gender, and education levels are controlled. Residence was coded as a dummy variable and "0=rural" and "1=urban". Gender was coded as a dummy variable and "0=male" and "1=female". Age was categorized into 4 groups and they were 15 to 17 yrs old, 18 to 20 yrs old, 21 to 23 yrs old, and 24 to 25 yrs old and they scored 1 to 4 respectively. Multicolineality was checked for each regression model.

Description of Results

Demographic characteristics

Participants' demographic characteristics are described in Table 1. Of 105 participants, 58% were male and 42% were female. The mean age of the sample was 19.1 years (SD= 3.3). Within the rural group, there were 3.6% participants who had a high-school education, 82.1% had a junior-high school education, and 14.3% of them had an education level of primary school or less. There were 6.3% participants in the migration group whose education level was more than a college degree, 12.5% of them graduated from college, 6.3% graduated from a technical school, 31.3% had a high-school education, 39.6% had a junior-high school education, and 4.2% of them had an education level of primary school or less.

About one fifth of the migration group (22.4%) had a stable employment but the majority of them (73.5%) were either temporary employees or unemployed. Most of the rural group was either students (61%) or peasants (32%). Only 15% of the participants were married or living as married and the rest were single. The average number of people per

household was 4.2 (SD=1.0); with 3.2 adults (SD=1.2) and 0.8 child (SD=.8) per household. The mean food expenditure per month was 55 Yuan (SD=76) for the rural group and 180 Yuan (SD=99) for the urban group. There was a significant difference between the monthly food expenditure of the rural and migration group (P=0.0001, 95% CI =90 to 160 Yuan per month). The average Body Mass Index (BMI) of the rural group and the migration group were 19.7±2.2 and 21.0±2.3, respectively. There was a significant difference between the average BMI of the rural group and the migration group (P<0.01, 95% CI=0.3 to 2.1). There were 39% of participants who smoked and 34% of them smoked every day.

Nutrient intakes

The mean values of nutrient intakes of the migration and rural groups are listed in Table 2. The mean total energy intake for male participants was 2167.7±693.5 kcal and for females, 1713.8±525.8 kcal. There was no significant difference between total energy intakes of the rural and urban male or female participants in the two groups. However, the diets of migration participants had significantly higher percentages of energy from fat and protein and a lower percentage of energy from carbohydrate than their rural counterpart (P<0.05, 95% CI=0.8 to 8.0; P=0.0001, 95% CI=0.8 to 2.6; P<0.01, 95% CI= -10.4 to –1.6, respectively). The mean fiber intake of the two groups was 12.0±4.5g and there was no significant difference between the fiber intake of the two groups. The cholesterol intake was much higher for the migration group of young adults than the rural group (P=0.001, 95% CI=114 to 433mg). The mean vitamin A intake of migration participants was as low as 388±289μg and this number was even significantly higher than the mean intake of 274±239μg of rural participants (P<0.05, 95% CI=11 to 218). Both groups had inadequate

calcium and zinc intakes (348±218mg and 10±5mg, respectively). There was no significant difference between the two groups in the mean intake of calcium and zinc. Results of the multiple linear regression model with a dependent variable "young adults' percentage of energy from protein" were listed in Table 3 (R-square=0.18, P=0.001). Urban residence was positively associated with young adults' energy percentages from protein when age, gender, and education levels were controlled (β=0.30, P=0.01).

Fruit and vegetable intake

The intake of fruit and vegetables and Stages of Change for all participants are reported in Table 4. The mean intake of fruit was 1.6±1.1 servings/day. The mean Stage of Change for vegetable intake of participants was 3.5±1.6, which indicates that their mean stage of vegetable intake was between the action stage and the maintenance stage. There was no significant difference between the migration group and the rural groups in their fruit intake. And there was no significant difference between the migration group and the rural groups in their stages of vegetable intake. The migration group had a significantly greater number of servings of vegetables than rural participants (P=0.0001, 95% CI = 0.5 to 1.5). However, they scored significantly lower on their Stages of Change for fruit intake than rural participants (P<0.01, 95% CI = 0.2 to 1.3). The mean Stage of Change for fruit intake of rural participants was 3.3±1.2, which was between the action stage and the maintenance stage. The mean Stage of Change for fruit intake of migration participants was 2.6±1.5, which was between the preparation stage and the action stage. Table 5 lists the results of the multiple linear regression predicting young adults' vegetable intake (R-square=0.14, P=0.004). Urban residence was positively associated with young adults' vegetable intake when age, gender, and educational levels were controlled (β=0.30, P=0.01).

Food availability and accessibility

The perception of food availability was measured by four items and the results are listed in Table 6. Scores on the perceived availability of animal foods, fruits, vegetables, and processed foods for the migration and the rural participants were not significantly different.

Food affordability was measured by six items and these responses are listed in Table 7. No difference in perceived affordability of animal foods, oil, vegetables, and processed foods were found between rural and urban migrant participants.

Food purchasing, preparation, and eating out

Migration participants spent more time helping their families purchase foods than rural participants (Mean scores of their responses were 2.8±0.8 and 3.0±0.8, $P<0.05$ 95%CI=-0.4 to 0). On average, migration and rural participants spent a similar estimate of time helping with cooking and their mean score of responses to the food preparation question was 2.6±0.9.

Migration participants had a significantly greater number of meals eaten away from home than rural participants (P=0.0001). The mean number of times of migration participants ate out during the week before the survey was 9.5±8.8 and this number for the rural participants was only 1.4±3.2. The 95% confidence interval was 6.2 to 9.9, which means that migration participants would have 6.2 to 9.9 more times of eating out per week than the rural participants. Migration young adults purchased meals from street vendors 3.1±6.2 times in the week before the survey, and rural young adults reported no such purchases. The means of number of times of those two groups purchasing meals from street vendor were significantly different (P=0.0001, 95% CI=1.9 to 4.3). On the average, migration participants reported

eating carryout meals 1.3±3.5 times in the week before the survey, and rural participants reported no intake of carryout meals (P=0.0001, 95% CI=0.6 to 1.9). The mean frequency of eating in a fast food restaurant by migration young adults was 1.3±2.8 times in the week before the survey and this number for rural participants was 0 (P=0.0001, 95% CI=0.8 to 1.9). Migration and rural participants ate meals in other restaurants for 2.5±4.9 and 2.8±4.3 times/week respectively and there was no statistical difference between these means. Similarly, there was no significant difference between the means for the frequencies that migration and rural young adults ate meals in the homes of others (0.3±0.9 vs. 0.2±0.8). The results of the multiple linear regression predicting the frequency of eating out for young adults are listed in Table 8 (R-square=0.29, P=0.0001). Urban residence was positively associated with the frequency of eating outside the home when age, gender, and educational levels were controlled (β=0.43, P=0.0001).

Diet-related health beliefs and health concerns

The survey instrument included seven items on the relationship between diet and health and two items evaluating health concerns. Young adults' responses to those items are listed in Table 9. The migration group had higher scores for the beliefs on the effects of excess dietary fat on the risk of some diseases than the rural group (P=0.001, 95%CI= 0.3 to 1.1). The migration group was more concerned about their health than the rural group (P=0.01, 95%CI=0.1 to 0.8).

Attitudes and intentions toward dietary transition related behaviors

Responses to the items measuring attitudes toward the dietary transition related behaviors are listed in Table 10. The migration group thought it was more important for them to have enough vegetables and fruits everyday than the rural group (P=0.0001, 95%CI= 0.6

to 1.3 for vegetable intake; P=0.0001, 95%CI=0.3 to 1.0 for fruit intake). The results of the multiple linear regressions predicting young adults' attitudes toward the importance of eating recommended amounts of fruits and vegetables are listed in Table 11 and 12 (R-square=0.28, P<0.0001 and R-square=0.15, P=0.004, respectively). Urban residence was positively associated with young adults' attitudes toward the importance of eating three servings of vegetables and two servings of fruits per day when age, gender, and educational levels were controlled (β=0.38, P=0.001 and β=0.29, P=0.015 respectively).

Responses to the items measuring intentions to make dietary transition related changes in their diet are listed in Table 13. The rural group thought they would be more willing to purchase more animal foods (P=0.0001, 95%CI= 0.6 to 1.4) and use more cooking oil (P=0.0001 95%CI=1.0 to 1.8) if their economic situation allowed than the migration group. There were more rural participants who wanted to go to fast food restaurants more often (27.8%) than migration participants (16.3%). The results of the multiple linear regressions predicting young adults' intentions to buy/have more animal foods, to cook dishes with more oil, and to have regular physical exercises are listed in Tables 14, 15, and 16 (R-squares were 0.25, 0.35, and 0.31 respectively and all three P values were less than 0.0001). When age, gender, and educational levels were controlled, urban residence was negatively associated with young adults' intentions to buy/have more animal foods (β=-0.54, P=0.0001), to cook dishes with more oil (β=-0.57, P=0.0001), and to have regular physical exercises (β=-0.57, P=0.0001).

Social support

Responses to the items about social support from their family members to encourage food consumption by food categories are listed in Table 17. The rural participants perceived

more social support from their family members for eating more animal foods than the migration group (P<0.05, 95%CI= 0.01 to 1.0). On the other hand, migrants perceived more social support from their family members for eating fruits and vegetables than the rural group (P=0.001, 95%CI= 0.3 to 1.3). The results of the multiple linear regression predicting young adults' perceived social support from family members on having fruits and vegetables are listed in Table 18 (R-square=0.23, P<0.0001). Urban residence was positively associated with young adults' perceived social support from family members on consuming fruits and vegetables when age, gender, and educational levels were controlled (β=0.58, P=0.0001).

Taste preferences

Responses to items describing the taste preferences of participants are listed in Table 19. Migrants liked the taste of animal foods, fruits, and vegetables more than the rural group (P=0.0001, 95%CI= 0.4 to 1.2; P=0.0001, 95%CI= 0.6 to 1.3; P=0.001, 95%CI=0.3 to 1.1, respectively). The rural group reported preferring the taste of processed foods more than the migrants (P<0.01, 95%CI= 0.2 to 1.1). The results of the multiple linear regressions predicting young adults' taste preferences for animal foods, fruits and vegetables are listed in Tables 20, 21, and 22 (R-squares were 0.19, 0.19, and 0.16 respectively and P values were <0.0001, <0.0001, and 0.003 respectively). Urban residence was positively associated with young adults' taste preferences for animal foods (β=0.30, P=0.01), fruits (β=0.48, P=0.0001), and vegetables (β=0.41, P=0.001) when age, gender, and educational levels were controlled.

Exposure to nutrition information

There was no significant difference between the migration and rural young adults on how much information about nutrition and a healthy diet they learned/read. With a mean score of 2.6±1.1, young adults had "A little" to "Some" exposure to nutrition information.

Further Discussion

This study found many differences between migrants and their rural counterparts in dietary practices and related attitudes and health behavior characteristics. Further analysis identified those differences that were significantly associated with the change of residency of young adults. Compared with rural-living participants, migrants had greater annual income and monthly food expenditure. The changes of SES status from rural peasants limited to a small piece of land to free labor working for wages in urban factories and consequent changes in their living environment and purchasing capacity are closely related to rural-urban migration and may account for the series of dietary changes associated with the residency change.

The results of this study showed that urban residence was associated with eating-out more frequently. This practice has been found to be associated with higher percentages of energy from protein and fat in the diet and usually people are less aware of the portion size and high energy density of foods when dining out (11). Street vendors, carryout meals, and fast food restaurants were popular in cities and migrants ate 60% of their meals away from home at those places. On the other hand, rural participants did not have any meals eaten away from home at fast food restaurants or from carryout or street vendors because those places were rare or non-existent in the rural villages. At the same time, there was no significant difference in the frequency of eating out at other restaurants or at the homes of others between the rural and migration young adults. The existence of those convenient street vendors, carryout meals, and fast food restaurants in cities was the major reason why migration participants reported eating out 6 to 10 times more often per week than rural

participants. Moreover, since migrants are exchanging labor for life necessities in urban areas, economic and time factors further promoted their eating-out practice.

Taste preference is another possible reason explaining the positive association between urban residence and protein and vegetable intake of young adults. The perceived good taste of food is an immediate benefit reinforcing the repeat of that food intake (12). This study found that moving from rural areas to urban areas was associated with greater taste preferences for animal foods, fruits, and vegetables, which is consistent with migrants' increased energy percentages from protein and vegetable intake.

Steptoe et al. found that social support can predict dietary change and the findings in their nutrition education intervention study indicated that greater increases in fruit and vegetable intake were achieved in the group with better baseline social support for dietary change (13). This study found that urban residence was associated with more perceived social support from their family members for consuming fruits and vegetables. This result suggests that greater social support from family members is one of the reasons for migrants' increased vegetable intake.

Our findings are consistent with previous research on the relationship between economic development and dietary transition and on the predictors of behavioral development. The results of this study suggested that the effects of urban residence on diets resulted from the interactive action of increased income and food expenditure with eating out more frequently, changes in food preferences, and more social support.

Attitudes and intentions can predict behaviors (14). A comforting finding of this study was that urban residence was not only positively associated with participants' attitudes

toward the importance of consuming the recommended amount of fruits and vegetables, but also negatively associated with their intentions toward purchasing more animal foods and oil. However, a warning sign is that urban residence was negatively associated with young adults' intentions to do more regular physical exercise, which demands special attention for future education.

In conclusion, the research findings of this study are critical for understanding how migration from rural to urban areas for employment has affected dietary intake and the degree of dietary transition indicated by the diet, behaviors and attitudes. However, the limitation of this study that it selected specific age group and geographic area limited the generalization of those research findings to other groups in the developing countries so that more regional studies are warranted in other developing countries to determine the underlying causes of the effects of urban living on dietary intake of rural-urban migrants and to serve as basis for designing appropriate interventions to blunt the progression of the nutrition transition to the degenerative disease stage in developing countries.

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Table 1. Comparison of demographic information of rural and migration young adults in Hebei, China

	Rural group (n=56)	Migration group (n=49)
Mean age (yrs old)	18	21
Gender (%)		
Male	55.4	61.2
Female	44.6	38.8
Education (%)		
Primary school or less	14.3	4.2
Junior high school	82.1	39.6
High school	3.6	31.3
Technical school	0	6.3
College	0	12.5
More than graduate school	0	6.3
Career (%)		
Worker	1.8	22.4
Military	1.8	0
Student	60.7	0
Temporary employee or unemployed	3.6	73.5
Peasant	32.1	4.1
Marital status (%)		
Married	16.1	14.3
Single	83.9	85.7
Family size[a]	4.2±1.0	4.1±1.1
Number of adults per family[a]	2.9±1.1	3.5±1.1
Number of children per family[a]	1.0±0.8	0.6±0.9
Food expenditure per month (Yuan)[a,b]	55±76	180±99
Smoking (%)		
Every day	23.2	34.0
Sometimes	1.8	12.8
Not at all	69.6	53.2
Body Mass Index (BMI)[a,b]	19.7±2.2	21.0±2.3

[a] The value is mean±SD.
[b] There was a significant difference between two groups, P<0.01.

Table 2. Comparison of nutrient intakes of rural and migration young adults in Hebei, China

Nutrient[a]	Rural group (n=56)	Migration group (n=49)
Total energy intake (kcal) Male Female	 2185.5±615.6 1743.3±536.5	 2149.3±776.1 1675.1±523.2
Fat energy percentage (%)[b]	16.6±8.2	21.0±10.1
Protein energy percentage (%)[b]	11.7±1.3	13.5±2.9
Carbohydrate energy percentage (%)[b]	73.1±9.4	67.1±12.7
Fiber (g)	12.3±4.3	11.6±4.7
Cholesterol (mg)[b]	209.8±306.7	483.2±481.7
Vit A (μg)[b]	273.9±239.2	388.3±289.3
Thiamine (mg)	1.3±0.5	1.2±0.7
Riboflavin (mg)	0.7±0.2	0.8±0.4
Niacin (mg)	11.8±5.3	14.3±13.1
Vit C (mg)	63.6±31.2	101.8±67.6
Vit E (mg)	16.8±7.2	18.4±12.4
Calcium (mg)	317.6±125.9	381.9±286.6
Zinc (mg)	9.6±2.8	10.7±6.8
Copper (mg)	2.2±0.8	6.4±2.4

[a] All values are mean±SD.
[b] There was a significant difference between the two groups, $P<0.05$.

Table 3. Results of the multiple linear regression model predicting young adults' percentage of energy from protein with four explanatory variables (R-square=0.18, P=0.001)

Independent Variables n = 105	b	Std. Error	β	t	P-value
Residence[a]	1.41	0.535	0.30	2.64	0.01
Education	0.34	0.24	0.16	1.41	0.16
Gender[b]	-0.62	0.43	-0.13	-1.42	0.16
Age	-0.04	0.25	-0.02	-0.18	0.86

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 4. Young adults' fruit and vegetable intakes and their stages of change of fruit and vegetable intake

Group	Servings of fruit intake (mean±SD)	Servings of vegetable intake (mean±SD)	Stages of change of fruit intake (mean±SD)	Stages of change of vegetable intake (mean±SD)
Migration	1.6±1.2	3.2±1.3[a]	2.6±1.5[b]	3.4±1.7
Rural	1.7±1.0	2.2±1.2	3.3±1.2	3.7±1.6

[a] Significantly higher than that of rural young adults (P=0.0001, 95% CI = 0.5 to 1.5)
[b] Significantly lower than that of rural young adults (P<0.01, 95% CI = 0.2 to 1.3)

Table 5. Results of the multiple linear regression model predicting young adults' vegetable intake with four explanatory variables (R-square=0.14, P=0.004)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	0.79	0.30	0.30	2.62	0.01
Education	-0.04	0.13	-0.03	-0.27	0.79
Gender[b]	0.12	0.25	0.04	0.47	0.64
Age	0.18	0.14	0.14	1.29	0.20

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 6. Perceived food availability by young adults in Hebei, China

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Is it convenient for you to buy animal foods as often as you want to?	Rural	10.7	28.6	26.8	33.9	0	0	NS
	Migration	8.2	32.7	4.1	44.9	10.2	0	
2. Is it convenient for you to buy fruits as often as you want to?	Rural	7.3	16.4	36.4	32.7	7.3	0	NS
	Migration	10.2	14.3	16.3	49.0	10.2	0	
3. Is it convenient for you to buy vegetables as often as you want to?	Rural	11.1	18.5	14.8	46.3	7.4	1.9	NS
	Migration	8.2	20.4	12.2	46.9	12.2	0	
4. Is it convenient for you to buy processed foods as often as you want to?	Rural	10.9	18.2	16.4	45.5	9.1	0	NS
	Migration	4.1	28.6	12.2	42.9	12.2	0	

[a] Participants' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 7. Perceived food affordability by young adults in Hebei, China

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Are animal foods expensive?	Rural	3.6	10.9	18.2	56.4	10.9	0	NS
	Migration	2.1	12.5	39.6	27.1	6.3	12.5	
2. Is oil expensive?	Rural	3.6	23.6	16.4	43.6	7.3	5.5	NS
	Migration	0	12.2	38.8	30.6	8.2	10.2	
3. Are fruits expensive?	Rural	7.3	25.5	21.8	27.3	5.5	12.7	NS
	Migration	4.1	40.8	26.5	20.4	2.0	6.1	
4. Are vegetables expensive?	Rural	5.5	23.6	23.6	32.7	5.5	9.1	NS
	Migration	0	36.7	34.7	18.4	4.1	6.1	
5. Are processed foods expensive?	Rural	11.1	20.4	29.6	27.8	7.4	3.7	NS
	Migration	2.0	22.4	42.9	24.5	2.0	6.1	
6. Are meals in fast food restaurants expensive?	Rural	15.1	30.2	28.3	20.8	3.8	1.9	0.007
	Migration	4.1	14.3	36.7	36.7	4.1	4.1	

[a] Participants' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 8. Results of the multiple linear regression model predicting young adults' weekly times of eating out with four explanatory variables (R-square=0.29, P=0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	6.57	1.61	0.43	4.09	0.0001
Education	1.03	0.72	0.15	1.44	0.15
Gender[b]	-0.82	1.31	-0.05	-0.63	0.53
Age	0.11	0.75	0.02	0.15	0.89

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 9. Diet-related health beliefs and health concerns of young adults in Hebei, China

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. What you eat can affect risk of getting cancer and heart disease	Rural	0	21.2	3.8	19.2	19.2	36.5	NS
	Migration	2.0	8.2	12.2	63.3	0	14.3	
2. How you exercise can affect risk of getting some diseases	Rural	1.8	29.1	10.9	9.1	5.5	43.6	NS
	Migration	2.0	28.6	6.1	49.0	2.0	12.2	
3. Eating more fruit and vegetables can affect risk of getting some diseases	Rural	3.6	39.3	5.4	21.4	3.6	26.8	NS
	Migration	4.1	24.5	12.2	42.9	0	16.3	
4. Eating too much fat can affect risk of getting some diseases	Rural	1.8	34.5	3.6	40.0	1.8	18.2	0.001
	Migration	2.0	4.1	10.2	61.2	4.1	18.4	
5. Eating a lot of animal foods can affect risk of getting some diseases	Rural	3.6	36.4	7.3	21.8	3.6	27.3	NS
	Migration	0	40.8	12.2	24.5	0	22.4	
6. Eating only fine grains can affect risk of getting some diseases	Rural	3.6	20.0	5.5	45.5	1.8	23.6	NS
	Migration	4.1	16.3	14.3	38.8	0	26.5	
7. It is extremely important to have balanced diet to prevent chronic diseases in later life	Rural	1.8	17.9	8.9	55.4	8.9	7.1	NS
	Migration	0	4.1	8.2	65.3	14.3	8.2	
8. I am very concerned about my health	Rural	1.8	14.5	10.9	45.5	21.8	5.5	0.01
	Migration	0	0	0	67.3	32.7	0	
9. I am trying hard to avoid getting ill	Rural	1.8	16.4	1.8	47.3	14.5	18.2	NS
	Migration	0	0	2.0	61.2	36.7	0	

[a] Participants' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 10. Attitudes of young adults in Hebei, China associated with diet-related behaviors

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Adding more animal foods indicates an improvement of the diet (meat, eggs, poultry, and fish)	Rural	0	27.8	11.1	29.6	5.6	25.9	NS
	Migration	4.1	24.5	28.6	30.6	4.1	8.2	
2. I prefer to have refined grains rather than whole grains	Rural	5.5	40.0	3.6	25.5	1.8	23.6	NS
	Migration	8.2	36.7	16.3	20.4	14.3	4.1	
3. It is important to eat 3 or more servings of vegetables per day	Rural	3.6	40.0	1.8	41.8	5.5	7.3	0.0001
	Migration	0	0	14.3	65.3	16.3	4.1	
4. It is important to eat 2 or more servings of fruits per day	Rural	5.4	26.8	7.1	51.8	3.6	5.4	0.0001
	Migration	0	4.1	16.3	61.2	16.3	2.0	
5. It is important to exercise for 30 to 60 minutes, at least 3 times per week (such as walking, biking, stair climbing, running etc)	Rural	3.6	12.7	3.6	49.1	18.2	12.7	NS
	Migration	0	10.2	12.2	61.2	12.2	4.1	

[a] Participants' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 11. Results of the multiple linear regression model predicting young adults' attitudes toward the importance of eating 3 or more servings of vegetables per day with four explanatory variables (R-square=0.28, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	0.77	0.23	0.38	3.35	0.001
Education	-0.10	0.10	-0.11	-0.97	0.34
Gender[b]	0.06	0.19	0.03	0.34	0.74
Age	0.29	0.11	0.29	2.64	0.01

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 12. Results of the multiple linear regression model predicting young adults' attitudes toward the importance of eating 2 or more servings of fruits per day with four explanatory variables (R-square=0.15, P=0.004)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	0.57	0.23	0.29	2.49	0.015
Education	-0.05	0.10	-0.05	-0.45	0.66
Gender[b]	0.08	0.19	0.04	0.44	0.66
Age	0.17	0.11	0.18	1.61	0.11

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 13. Intentions of young adults in Hebei, China toward diet-related behaviors

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. If economic situation allows, I will buy/have more animal foods (meat, eggs, poultry, and fish)	Rural	0	12.5	8.9	53.6	23.2	1.8	0.0001
	Migration	0	46.9	18.4	26.5	4.1	4.1	
2. If economic situation allows, I will cook dishes with more oil (vegetable oil and/or animal fat)	Rural	1.8	19.6	5.4	42.9	26.8	3.6	0.0001
	Migration	4.1	67.3	14.3	12.2	0	2.0	
3. If economic situation allows, I will buy more processed food (like cookies, snacks, French fries, and potato chips etc.)	Rural	5.4	57.1	14.3	14.3	3.6	5.4	NS
	Migration	8.2	59.2	8.2	24.5	0	0	
4. If economic situation allows, I will go to fast food restaurants more often	Rural	9.3	59.3	0	20.4	7.4	3.7	NS
	Migration	18.4	49.0	12.2	16.3	0	4.1	
5. If economic situation and time allows, I will regularly do exercises for 30 to 60 minutes, at least 3 times per week	Rural	8.9	46.4	7.1	26.8	5.4	5.4	0.0001
	Migration	0	6.1	8.2	69.4	16.3	0	
6. I will follow dietary recommendations to have a balanced diet to prevent chronic diseases in later life, though they are not as tasteful as my regular diet	Rural	3.6	23.2	10.7	37.5	8.9	16.1	0.022
	Migration	0	8.2	12.2	77.6	2.0	0	

[a] Young adults' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 14. Results of the multiple linear regression model predicting young adults' intentions to buy/have more animal foods with four explanatory variables (R-square=0.25, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	-1.15	0.23	-0.54	-4.93	0.0001
Education	0.19	0.11	0.18	1.71	0.09
Gender[b]	0.23	0.19	0.10	1.17	0.25
Age	-0.03	0.11	-0.03	-0.28	0.78

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 15. Results of the multiple linear regression model predicting young adults' intentions to cook dishes with more oil with four explanatory variables (R-square=0.35, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	-1.36	0.24	-0.57	-5.58	0.0001
Education	0.09	0.11	0.08	0.86	0.39
Gender[b]	-0.07	0.20	-0.03	-0.33	0.74
Age	-0.14	0.12	-0.12	-1.21	0.23

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 16. Results of the multiple linear regression model predicting young adults' intentions to have regular physical exercise with four explanatory variables (R-square=0.31, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	1.04	0.24	0.46	4.31	0.0001
Education	0.36	0.11	0.04	0.34	0.73
Gender[b]	0.16	0.20	0.07	0.82	0.41
Age	0.13	0.12	0.11	1.11	0.27

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 17. Perceived social support from family members on food consumption by young adults in Hebei, China

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Somebody in my family prefers more animal foods and this preference affects what the family eats	Rural	25.9	24.1	13.0	22.2	7.4	7.4	0.046
	Migration	26.5	42.9	14.3	4.1	4.1	8.2	
2. Somebody in my family prefers a lot of oil and this preference affects what the family eats	Rural	27.8	13.0	13.0	29.6	9.3	7.4	NS
	Migration	20.4	26.5	32.7	8.2	4.1	8.2	
3. Somebody in my family prefers a lot of fruit and vegetables and this preference affects what the family eats	Rural	36.4	34.5	1.8	20.0	0	7.3	0.001
	Migration	14.3	28.6	6.1	38.8	4.1	8.2	
4. Somebody in my family prefers processed food and this preference affects what the family eats	Rural	16.4	52.7	9.1	12.7	5.5	3.6	NS
	Migration	10.2	36.7	14.3	26.5	4.1	8.2	
5. Somebody in my family prefers fast food restaurants and this preference affects what the family eats	Rural	23.6	40.0	16.4	16.4	3.6	0	NS
	Migration	10.2	49.0	14.3	16.3	4.1	6.1	

[a] Young adults' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 18. Results of the multiple linear regression model predicting young adults' perceived social support from family members on having fruits and vegetables with four explanatory variables (R-square=0.23, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	1.44	0.28	0.58	5.11	0.0001
Education	-0.23	0.12	-0.21	-1.87	0.07
Gender[b]	-0.12	0.24	-0.05	-0.52	0.61
Age	-0.33	0.13	-0.27	-2.54	0.01

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 19. Taste preference of young adults in Hebei, China

Items	Group	Percentage (%)						P-value for the t-test[a]
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Do not know	
1. Animal foods taste good	Rural	18.5	46.3	11.1	20.4	1.9	1.9	0.0001
	Migration	2.0	22.4	30.6	36.7	6.1	2.0	
2. Dishes with more oil taste good	Rural	14.8	42.6	13.0	22.2	3.7	3.7	NS
	Migration	4.1	36.7	26.5	26.5	4.1	2.0	
3. Refined grains taste better than whole grains	Rural	12.7	43.6	10.9	23.6	3.6	5.5	NS
	Migration	6.1	38.8	16.3	28.6	8.2	2.0	
4. Fruits taste good	Rural	9.1	34.5	14.5	32.7	5.5	3.6	0.0001
	Migration	0	8.2	14.3	61.2	16.3	0	
5. Vegetables taste good	Rural	7.3	23.6	25.5	27.3	10.9	5.5	0.001
	Migration	2.0	6.1	18.4	59.2	14.3	0	
6. Processed foods taste good	Rural	7.5	18.9	13.2	45.3	13.2	1.9	0.003
	Migration	6.1	40.8	26.5	26.5	0	0	
7. The foods served at fast food restaurants taste good	Rural	7.5	22.6	18.9	41.5	7.5	1.9	NS
	Migration	2.0	40.8	28.6	26.5	2.0	0	

[a] Young adults' responses to survey items were scored as 0 to 5 and were treated as continuous variables when the means of the two groups were compared. "Do not know" scored "5" and was treated as a missing value.

Table 20. Results of the multiple linear regression model predicting young adults' taste preferences for animal foods with four explanatory variables (R-square=0.19, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	0.65	0.25	0.30	2.59	0.01
Education	-0.01	0.12	-0.01	-0.10	0.92
Gender[b]	0.11	0.21	0.05	0.55	0.58
Age	0.24	0.12	0.22	2.07	0.04

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 21. Results of the multiple linear regression model predicting young adults' taste preferences for fruits with four explanatory variables (R-square=0.19, P<0.0001)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	1.05	0.25	0.48	4.27	0.0001
Education	-0.15	0.11	0.16	-1.42	0.16
Gender[b]	-0.16	0.20	-0.07	-0.78	0.44
Age	0.09	0.11	0.08	0.79	0.43

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

Table 22. Results of the multiple linear regression model predicting young adults' taste preferences for vegetables with four explanatory variables (R-square=0.16, P=0.003)

Independent Variables n =105	b	Std. Error	β	t	P-value
Residence[a]	0.86	0.25	0.41	3.50	0.001
Education	-0.27	0.11	-0.28	-2.43	0.017
Gender[b]	-0.11	0.20	-0.05	-0.53	0.60
Age	0.11	0.12	0.11	0.97	0.33

[a] Residence was coded as a dummy variable and "0=rural" and "1=urban"
[b] Gender was coded as a dummy variable and "0=male" and "1=female"

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Conclusions

This research study investigated dietary intakes of the urban high-income, urban low-income, rural-urban migrating, and rural young adults and tested the differences of the dietary intakes among those four SES groups. The urban high-income group had a significantly higher dietary intake of protein, fat and cholesterol and lower intakes of carbohydrate and fiber than the other three low-income groups. The migration young adults had significantly higher percentages of energy from fat and protein and a lower percentage of energy from carbohydrate than their rural counterparts. The urban low-income young adults consumed a very similar diet to the migration young adults. The urban high-income group with 58.4% of dietary energy coming from carbohydrates, 28.7% of energy from fat, and 14.2% of energy from protein, had a more westernized diet than participants from the other three SES groups indicating a greater progression of the dietary transition process.

Among the three low-income SES groups, the urban low-income group is the group with the greatest tendency toward a more westernized diet and the rural-urban migration group had the second highest tendency. In our preliminary study, most urban-living low-income young adults (about 91% of them) thought that adding more animal foods indicated an improvement of the diet and 72.8% of them preferred to eat foods prepared with refined grains. Over half of the urban-living low-income young adults (63.7%) indicated they would purchase more animal foods if their economic situation allowed. More than one-fifth of urban low-income young adults said they would use more cooking oil/animal fat and they would go to fast food restaurants if economic situation allowed. At the same time, the urban low-

income group was the group that engaged in the least physical activity. With increased economic resources, the urban low-income group has the potential to choose diets characteristic of the degenerative stage in the nutrition transition model. Public health education interventions can change the shape of dietary changes.

Urbanization associated with the migration of rural young adults into the cites has caused dietary changes for the migrants. The changes in energy composition and intake from food groups included increased percentage of energy from fat and protein and increased vegetable intake. Urban residence was associated with eating away from home and purchasing food more often. Moreover, the increased income, improved food availability and accessibility in cities may partially explain the dietary differences between migrant and rural-living young people. These results suggest that the food preferences of young adults were associated with urban residence and those who had migrated to the city for employment preferred the taste of animal foods, dishes with more oil, refined grains, fruits, and vegetables than their rural counterparts. Social support perceived by migration young adults further promoted their dietary changes in cities.

The PRECEDE-PROCEED model was used to study the nutrition transition process and to identify modifiable factors for future efforts to diminish the harmful dietary changes. A total of 12 factors were identified by applying the predisposing, enabling, and reinforcing constructs of the PRECEDE-PROCEED model. There were four factors in the predisposing construct and they were people's beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and fine grains and their beliefs in the relationship between chronic diseases and having 3 or more vegetables and 2 or more fruits every day, people's health concerns, and people's intentions toward having more animal foods, oil, and

processed foods. The enabling construct consists of three factors: food availability and accessibility, cost of animal foods, oil, and processed foods, and cost of fruits and vegetables. The factors in the reinforcing construct included social support for unprocessed food, social support for processed food, taste preference for animal foods, oil, and refined grains, taste preference for fruits and vegetables, and taste preference for processed foods. Young adults' beliefs in the relationship between chronic diseases and dietary intake of fat, animal foods, and processed grains, their taste preference for processed foods and fruits and vegetables, and cost of fruits and vegetables were more important predicting their dietary changes than the rest seven factors in the models. When age, gender, and education levels were controlled, beliefs about the relationship between dietary fat, animal food and processed grain consumption and risk of chronic diseases, taste preference for processed foods, and cost of fruits and vegetables stayed important predicting young adults' dietary changes. Among those important factors, people's beliefs about diet and health are modifiable and they should be the targeted by public health workers to design and carry out effective intervention programs to redirect dietary transition to healthier outcomes.

Future Work

There is a great need in China to prevent an epidemic of chronic diseases caused by harmful nutrition transition behaviors. Based on the findings of the factors predicting dietary changes, educational intervention programs to correct wrong beliefs about diet and health and to increase social support toward healthy dietary habits should be a public health priority. Media and social marketing to publicize nutrition messages is appropriate in China where most people have not had systemic nutrition education and have limited nutrition knowledge.

Different populations have their unique nutrition problems so nutrition intervention programs designed for the selected population is recommended. An area of the future work is to design intervention materials tailored for audiences with diversified education levels and within different SES groups.

A comprehensive national strategy is needed to deal with the long-term threat of chronic diseases in China. For example, an incorporation of nutrition knowledge into the education in elementary schools would be a good propose to publicize nutrition knowledge and reverse the worsening prevail of child obesity. Predominant media would be promising tools to reach targeted population to disseminate nutrition messages. The local public health agencies, together with community workers, can deliver nutrition messages to households.

Longitudinal studies on nutrition transition are needed not only for expanding the knowledge about nutrition transition but also for the surveillance of the status of nutrition transition because only longitudinal studies can detect the velocity of nutrition transition among various populations. Results from longitudinal studies will be especially meaningful for both the research and public health work and are highly expected.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

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DATE: October 7, 2004

TO: Mary Jane Oakland

FROM: Ginny Eason, IRB Administrator

RE: **IRB ID # 04-239**

STUDY REVIEW DATE: May 3, 2004

The Institutional Review Board has reviewed the project, *"Dietary Transition in Populations with Different Social Economic Status in China"* requirements of the human subject protections regulations as described in 45 CFR 46.101(b) 2. The applicable exemption category is provided below for your information. Please note that you must submit all research involving human participants for review by the IRB. Only the IRB may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

The IRB determination of exemption means that this project does not need to meet the requirements from the Department of Health and Human Service (DHHS) regulations for the protection of human subjects, unless required by the IRB. We do, however, urge you to protect the rights of your participants in the same ways that you would if your project was required to follow the regulations. This includes providing relevant information about the research to the participants.

Because your project is exempt, you do not need to submit an application for continuing review. However, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent if you have stated in your application that you will do so or required by the IRB.

Any modification of this research must be submitted to the IRB on a Continuation and/or Modification form, prior to making any changes, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

cc: FSHN

Applicable exemption category(s):

The Administrator will choose one.

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(5) Research and demonstration projects which are conducted by or subject to the approval of Department or Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

ISU IRB # 2 | 04-239
EXEMPT DATE | May 3, 2004

Modified Informed Consent Form

(The following information will be verbally conveyed to participants)

Introduction

You are invited to be in a research study of investigating dietary intake and life style. This study is being conducted by Iowa State University and you are selected as a possible participant. We ask that you read this document and ask any questions you may have before agreeing to be in the study.

Background Information

Rapid and imbalanced economic development in China causes an imbalance in the development of dietary patterns and life styles in different segments of the population, which will result in various nutritional and health problems. By observing incidence of chronic diseases in selected urban and rural areas and studying chronic disease-related factors, we may expand the knowledge about how to prevent chronic diseases. This research may also serve as a basis for designing appropriate intervention method to prevent chronic disease. In developing countries, a shared characteristic is, as dietary patterns change to include higher energy, meat, and fat intakes there is also a decrease in plant based items in the diet and subsequently increased risk for chronic diseases. With timely nutrition intervention, it may be possible to avoid the deleterious dietary effects often associated with economic transition in developing countries

Procedures

If you agree to participate in this study, we will ask you to finish our questionnaires and tell us what you had yesterday, which will take about one hour.

Risks and Benefits of Being in the Study

This study will have no known risk. The benefits of participation are: you may improve your dietary intakes and have all health improving effects related to increasing fruit and vegetable intakes and decreasing fat intake including weight control, decreased risk of cardiovascular diseases and some cancer.

Confidentiality

The records of this study will be kept private. Since questionnaires will ask only for gender and age, it has been made impossible to identify subjects by name. Consent forms will be kept securely along with results for seven years after completion of this study.

ISU IRB # 2 04-239
EXEMPT DATE: May 3, 2004

Voluntary Nature of the Study

Your decision whether or not to participate will not affect your current or future relations with Iowa State University. If you decide to participate, you are free to withdraw at any time without affecting your relationship with Iowa State University.

Contacts and Questions

This research is under the direction of Mary Jane Oakland, PhD, and Jie Mao, MS, at Iowa Sate University. If you have any questions, you may contact the following:

Mary Jane Oakland, PhD, RD, LD
Ph: 515-294-2536

Jie Mao, MS
Ph: 515-294-9377

Thank you for your participating!

Chronic Disease Risk Factor Survey

Section 1:Demographics

1. Age
2. Sex
3. How far have you gone in School
    1. No school
    2. Primary school
    3. Junior high
    4. High school
    5. Technical school
    6. College
    7. More than graduate school
4. Occupation
    1. Agriculture and Fisheries
    2. Mining and Minerals
    3. General Construction
    4. Manufacture and General Production
    5. Transportation and Communication
    6. Public Service
    7. Student
    8. Temporary worker or unemployed
5. What is your marital status?
    1. Married
    2. Single
    3. Separated
    4. Widowed
    5. Divorced
    6. Cohabited
6. What is your total yearly income from all sources?
7. How many people living in your home, including yourself?___
8. Measurements:
   Height (cm):
   Weight (kg):
   Resting Pulse (times/min):
   Blood pressure (mmHg):

Section 2: Medical history and family history

1. Have you or any of your family members been told by a physician that you had Diabetes Mellitus?
    1. No.
    2. Yes. If yes

You Family Member and your relationship

Diabetes type I
Diabetes type II
Glucose intolerance /Pre-diabetes

3. Have you or any of your family members been told by a physician that you had cardiovascular disease?

1. No.
2. Yes. If yes, which kind of disease did/do you have?

You Family Member and your relationship

Pulmonary heart disease
Congenital cardiovascular diseases
Heart failure
Cardiac arrhythmias
Coronary heart disease
(Angina pectoris
Myocardinal infarction)
Atherosclerosis
Hypertension
(Normal<130/85mmHg
High normal: 130-139/85-89mmHg
Stage I: 140-159/90-99mmHg
Stage II-IV≥160/100mmHg)
Valvular heart disease
Cardiomyopathy

4.Have you or any of your family members been told by a physician that you had hyperlipidemia?

1.No.
2.Yes. Who?_____

5.Have you or any of your family members been told by a physician that you had stroke?

1.No.
2.Yes. If yes, ischemic or hemorrhagic? Who?_____

6.Have you or any of your family members been told by a physician that you had respiratory system disease?

1.No.
2.Yes. If yes, which kind of disease did/do you have

You Family Member and your relationship

Asthma
Chronic bronchitis
Pulmonary emphysema
Pneumonia

7. Have you or any of your family members been told by a physician that you had any cancer?

1. No.
2. Yes. If you had/have, please indicate which one you had/have. If your family member(s) had/have, please indicate which one she/he had/has and your relationship.

You	Family Member and your relationship
	Cancer of the oropharynx
	Cancers of the upper aerodigestive tract
	Lung cancer
	Esophageal cancer
	Gastric cancer
	Pancreatic cancer
	Liver cancer
	Breast cancer
	Prostate cancer
	Cancer of the kidney
	Bladder cancer
	Colorectal cancer
	Lymphoma
	Leukemia
	Other cancers:

8. Have you or any of your family members been told by a physician that you had digestive system disease?

1. No.
2. Yes. If yes, do you have any of the following diseases?

You	Family Member and your relationship
	Ulcer
	Diseases of the colon
	Gallbladder disease
	Liver disease
	Hepatitis: A
	B
	C

9. Have you or any of your family members been told by a physician that you had tuberculosis?

1. No.
2. Yes. Who?_____

10.Have you or any of your family members been told by a physician that you had any of these following disorders?

You	Family Member and your relationship

Alcohol or other substance abuse problem
Depression
Eating disorder
Anemia
Obesity

Section 3: Life Style
Module 1: Physical Activity

1. When you are at work, which of the following best describes what you do?
    1. Mostly sitting or standing
    2. Mostly walking
    3. Mostly heavy labor or physically demanding work

We are interested in two types of physical activity: vigorous and moderate. Vigorous activities cause large increases in breathing or heart rate while moderate activities cause small increases in breathing or heart rate.

2. Now, thinking about the moderate physical activities you do in a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate?
    1. Yes
    2. No. Go to Q5
    3. Don't know/ Not sure. Go to Q5
3. How many days per week do you do these moderate activities for at least 10 minutes at a time? _____days per week
4. On days when you do moderate activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?_____minutes per day
5. Now thinking about the vigorous physical activities you do in a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate?
    1. Yes
    2. No. Go to next module
6. How many days per week do you do these vigorous activities for at least 10 minutes at a time?_____days per week
7. On days when you do vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities? _____minutes per day

Module 2: Food and Diet

1.How often do you do or help with the food shopping for your home?
    1. Almost always
    2. About ½ time
    3. Seldom
    4. Never
2.How often do you do or help with the cooking for your home?
    5. 1. Almost always

6. About ½ time
7. Seldom
8. Never

3. How many meals do you eat away from home each week?
   Street/market vendors: ____times
   Carry out: ____times
   Fast food restaurant: ___times
   Other restaurants: _____times
   Other people's home: ___times

Module 3: Tobacco Use

1. Have you smoked at least 100 cigarettes in your entire life?
   1. Yes
   2. No
2. Do you smoke cigarettes currently?
   1. Every day
   2. Some days
   3. Not at all
3. How many cigarettes do you smoke every day?
   1. 0
   2. Fewer than 5
   3. 5-10
   4. >10
4. During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?
   1. Yes
   2. No

Module 4: Alcohol consumption

1. During the past month, how many days did you drink alcoholic beverage?
   _____days

2. During the past week, how many days did you drink alcoholic beverage?
   _____days

3. On the days when you drank, about how much did you drink on the average?
   (1)____50g wine (2) ____bottle(s) of beer (3) ____ 50g grape wine

4. Considering all types of alcoholic beverages, how many days____ during the past 30 days did you have more than: (1) 250g wine (2) 5 bottles of beer (3) 250g grape wine

Questions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Don't know
1. Dietary habits can affect risk of getting cancer and heart disease						
2. How you exercise can affect risk of getting some diseases						
3. Eating more fruit and vegetables can affect risk of getting some diseases						
4. Eating too much fat can affect risk of getting some diseases						
5. Eating a lot of animal foods can affect risk of getting some diseases						
6. Eating only fine grains can affect risk of getting some diseases						
7. Adding more animal foods indicates an improvement of the diet (meat, eggs, poultry, and fish)						
8. I prefer to have refined grains rather than whole grains						
9. It is important to eat 3 or more servings of vegetables per day						
10. It is important to eat 2 or more servings of fruits per day						
11. It is important to exercise for 30 to 60 minutes, at least 3 times per week (such as walking, biking, stair climbing, running etc)						
12. It is good to use more household appliances (such as washing machine, microwave, dishwasher etc.)						
13. It is extremely important to have balanced diet to prevent chronic diseases in later life						
14. I am very concerned about my health						
15. I am trying hard to avoid getting ill						
16. If economic situation allows, I						

will buy/have more animal foods (meat, eggs, poultry, and fish)						
17. If economic situation allows, I will cook dishes with more oil (vegetable oil and/or animal fat)						
18. If economic situation allows, I will buy more processed food (like cookies, snacks, French fries, and potato chips etc.)						
19. If economic situation allows, I will go to fast food restaurants more often						
20. If economic situation allows, I will use more household appliances (such as washing machine, microwave, dishwasher etc.)						
21. If economic situation and time allows, I will regularly do exercises for 30 to 60 minutes, at least 3 times per week						
22. I will follow dietary recommendations to have a balanced diet to prevent chronic diseases in later life, though they are not as tasteful as my regular diet						
23. Were you aware of any nutrition materials from the radio, TV, magazine, newspaper, or the poster?	Never	A little	Some	A lot		
24. Have you learned/read any information about nutrition and a healthy diet?	Never	A little	Some	A lot		
25. Is it convenient for you to buy animal foods?						
26. Is it convenient for you to buy fruits?						
27. Is it convenient for you to buy vegetables?						
28. Is it convenient for you to buy processed foods?						
29. Are animal foods expensive?						
30. Is oil expensive?						

31. Are fruits expensive?						
32. Are vegetables expensive?						
33. Are processed foods expensive?						
34. Are meals in fast food restaurants expensive?						
35. Somebody in my family prefers more animal foods and this preference affects what the family eats						
36. Somebody in my family prefers a lot of oil and this preference affects what the family eats						
37. Somebody in my family prefers a lot of fruit and vegetables and this preference affects what the family eats						
38. Somebody in my family prefers processed food and this preference affects what the family eats						
39. Somebody in my family prefers fast food restaurants and this preference affects what the family eats						
40. Animal foods taste good						
41. Dishes with more oil taste good						
42. Refined grains taste better than whole grains						
43. Fruits taste good						
44. Vegetables taste good						
45. Processed foods taste good						
46. The foods served at fast food restaurants taste good						

慢性疾病危险因素调查

第一部分：人口学特征

9. 年龄：_____ 岁
10. 性别： （1）男 （2）女
11. 文化程度：
（1）未上过学 （2）小学 （3）初中 （4）高中 （5）技校 （6）大学 （7）研究生以上
12. 职业：
（1）农牧渔业 （2）采矿业 （3）建筑业 （4）制造与一般生产 （5）交通和通讯 （6）公众服务 （7） 学生 （8）临时工或无固定职业者
13. 婚姻状态：
（1）已婚 （2）未婚 （3）分居 （4）寡居 （5）离婚 (6) 同居
14. 年收入（包括所有来源）_____ 元？
15. 家庭人口数：____人
16. 身体测量
身高_____cm 体重 ____ kg 脉搏 ____ 次 血压 ____ mmHg

第二部分：既往病史和家族史

1.你和你的家人有没有糖尿病人？
3. 没有
4. 有，如果有

你	家庭成员与你的关系
I 型糖尿病	
II 型糖尿病	
糖耐量异常	

3. 你和你的家人有没有心血管疾病的病人？
3. 没有
4. 有，如果有，是哪一种类型

你	家庭成员与你的关系
肺心病	
先心病	
心力衰竭	
心律不齐	
冠心病 (心绞痛；心肌梗塞)	
动脉硬化	
高血压	
(正常<130/85mmHg ；	
正常高值 130-139/85-89mmHg ；	
I 期高血压 140-159/90-99mmHg；	
II-IV 期高血压：≥160/100mmHg)	
心脏瓣膜病	
心肌病	

4. 你和你的家人有没有高脂血症的病人
1.没有

2.有, 谁_____

5. 你和你的家人有没有中风的病人？
1.没有
2.有， 如果有，血栓还是出血，谁_____

6. 你和你的家人有没有呼吸系统疾病的病人？
1. 没有
2. 有，如果有，是哪一种类型？

你 家庭成员与你的关系

哮喘
慢性支气管炎
肺气肿
肺炎

7. 你和你的家人有没有癌症的患者？
3. 没有
4. 有，如果你患有癌症，请指出是哪一种癌；如果是你的家庭成员患有癌症，请指出是哪一种癌，并写明你们的关系。

你 家庭成员，与你的关系_____ 。

口腔癌
上消化道癌
肺癌
食管癌
胃癌
胰腺癌
肝癌
乳腺癌
前列腺癌
肾癌
膀胱癌
结肠直肠癌
淋巴瘤
白血病
其他癌症

8. 你和你的家人有没有消化系统疾病的病人？
3. 没有
4. 有，如果有，是以下哪些类型？

你 家庭成员与你的关系

溃疡
结肠疾病
胆囊疾病
肝脏疾病
肝炎： 甲型
乙型

丙型

9. 你和你的家人有没有结核的病人？

3. 没有
4. 有，谁_____

10. 你和你的家人有没有以下方面的问题

你　　家庭成员与你的关系

酒精或其他物质的依赖（成瘾）
抑郁症
饮食失调
贫血
肥胖

第三部分：生活方式

一 、体力活动

8. 你的工作情况：当你工作的时候，你

1. 主要是坐着或站着
2. 主要是走动
3. 主要是重体力劳动

我们对以下两种类型的体力活动比较关注：强体力活动和中等体力活动。强体力活动引起呼吸频率和脉搏增加的幅度较大，而中等体力活动引起呼吸频率和脉搏增加的幅度较小。

9. 回想一下， 通常一周当中， 你平时的中等体力活动 ，每次至少有 10 分钟吗？比如快速走路，骑自行车，用吸尘器打扫房间， 修理你的小花园，或 任何其他引起呼吸/心率轻度增加的活动。

1. 是
2. 不是，请 跳过 3 和 4，回答问题 5 。
3. 不知道/不确定，请 跳过 3 和 4， 回 答问题 5 5 。

10. 一周当中，你有几天从事不低于 10 分钟的中等体力的劳动？
天。

11. 在你从事每次不低于 10 分钟中等体力活动的那些天中，你每天所花费的总时间有多少分钟？

12. 回想一下你平时的重度体力活动 ， 通常一周当中， 每次至少有 10 分钟吗？比如跑步，有氧运动，比较重的庭院劳动，或其他引起呼吸 /心率大幅度增加的活动。

1. 是
2. 不是. 跳过问题 6 和 7.

13. 你每周有几天从事每次不低于 10 分钟的重体力活动 ？

14. 在你从事每次不低于 10 分钟重体力活动的那些天中，你每天所花费的总时间有多少分钟？

二、食物和膳食

1. 你经常为你的家庭购买一食物吗？

1. 几乎总是
2. 大概 1/2 的次数
3. 很少

4. 从不

2. 你经常为你的家庭做饭或帮着做饭吗？
   1. 几乎总是
   2. 大概 1/2 的次数
   3. 很少
   4. 从不

4. 每周你有多少次不在家里吃饭？
   街头/市场售货车：_____ 次
   外卖口：_____ 次
   快餐店：_____ 次
   其他餐馆：_____ 次
   别人家 _____ 次

三、吸烟量

1. 在你的一生中，你吸过不少于 100 支香烟吗？
   3. 是的
   4. 没有
2. 你经常吸烟吗？
   4. 每天都吸
   5. 有时吸
   6. 从来不吸
3. 每天你吸几支烟？
   5. 0 支
   6. 少于 5 支
   7. 5-10 支
   8. >10 支
4. 在过去的一年中，你有没有因试图戒烟而停止吸烟 1 天或更长的时间？
   3. 有
   4. 没有

四、酒精的摄入量

5. 在过去的一个月当中，你有多少天喝酒？_____ 天。
6. 在过去的一个星期当中，你有多少天喝酒？_____ 天。
7. 你每次大约喝多少酒 ？
   （1）_____. 两白酒 （2）____ 瓶 啤酒 （3）_____两葡萄酒
8. 在一个月当中，你有_____ 天酒量超过了：
   （1）半斤白酒 （2） 5 瓶 啤酒 （3）半斤葡萄酒

问题	强烈反对	不同意	既不同意也不反对	同意	强烈同意	不知道
饮食可以影响得癌症和心脏病的可能性						
运动可以影响得癌症和心脏病的可能性						
吃水果蔬菜可以影响得癌症和心脏病的可能性						
吃很多脂肪(油，肥肉)会影响得癌症和心脏病的可能性						
吃很多动物食品(如肉，蛋，禽类，鱼虾等)会影响得癌症和心脏病的可能性						
只吃精粮（如精米、精面）会影响得癌症和心脏病的可能性						
增加更多的动物食品(如肉，蛋，禽类，鱼虾等) 意味着饮食的改善						
我更喜欢吃精制的谷类主食（如精米、精面）而不喜欢吃粗制的主食（如全麦面，即黑面粉）						
每天吃3份或3份以上的蔬菜很重要						
每天吃2个或2个以上的水果很重要						
每周至少锻炼3次，每次锻炼30到60分钟很重要						
使用更多的家用电器（如洗衣机、微波炉、洗碗机等）是不错的一件事						
平衡膳食对预防以后生活中可能出现的慢性病非常重要						
我非常关心我的身体健康						
我努力避免生病						

如果经济条件允许，我会买/吃更多的动物性食品（如肉、鸡蛋、禽类和鱼虾等）						
如果经济条件允许，我炒菜会用更多的油（动物油和/或植物油）						
如果经济条件允许，我会买更多的加工的食品（如零食，糕点，油炸食品，香肠等）						
如果经济条件允许，我会去更多次快餐店						
如果经济条件允许，我会使用更多的家用电器（如洗衣机、微波炉、洗碗机等）						
如果经济条件和时间允许，我会每周至少锻炼3次，每次锻炼30到60分钟						
我会遵从饮食推荐吃平衡膳食以预防以后生活中可能出现的慢性病，**虽然平衡膳食并不一定象我平时的食物那么好吃。**						
在广播，电视，杂志，报纸，或是宣传画里，你有没有注意到过任何营养知识?	**从来没有**	**一点点**	**有一些**	**很多**	**_____**	**_____**
你读/听/学到过任何关于营养和健康饮食的知识吗？	**从来没有**	**一点点**	**有一些**	**很多**	**_____**	**_____**
买动物食品方便吗？						
买水果方便吗？						
买蔬菜方便吗？						
买加工过的食品方便吗？						
动物食品贵吗？						
油贵吗？						
水果贵吗？						
蔬菜贵吗？						
加工过的食品贵吗？						

在快餐店吃贵吗？						
我们家有人喜欢吃/烧动物食品，影响了我们家的饮食						
我们家有人喜欢吃油多的菜或炒菜多放油，影响了我们家的饮食						
我们家有人喜欢吃水果蔬菜，影响了我们家的饮食						
我们家有人喜欢吃加工过的食品，影响了我们家的饮食						
我们家有人喜欢吃快餐，影响了我们家的饮食						
动物食品好吃						
油多一些的菜好吃						
精粮比粗粮好吃						
水果好吃						
蔬菜好吃						
加工过的食品好吃						
快餐好吃						

食用蔬菜 Vegetables	摄入量 Amount of intake (g)
1. 扁豆 Green beans	
2. 豇豆（长豆角) Long Chinese beans	
3. 其他豆类 Other beans	
4. 马铃薯 Potatoes	
5. 红(白)薯 Sweet potatoes and Yams	
6. 胡萝卜 Carrots	
7. 白萝卜 White radishes	
8. 白菜 Chinese cabbages	
9. 油菜 Cole	
10. 卷心菜 Cabbages	
11. 菠菜 Spinach	
12. 茴香 Fennel	
13. 芹菜 Celery	
14. 根达菜	
15. 韭菜 Leek	
16. 蒜 Garlic	
17. 蒜薹 Garlic stalk	
18. 蒜苗 Green garlic	
19. 大葱 Shallot	
20. 小葱 Green onion	
21. 洋葱 Onion	
22. 菜花 Cauliflower	
23. 南瓜 Pumpkin	
24. 西葫芦 Calabash gourd	
25. 冬瓜 Wintermelon	
26. 黄瓜 Cucumber	
27. 茄子 Eggplant	
28. 番茄 Tomato	
29. 青椒 Green peppers	
30. 蘑菇 Mushrooms	
合计 Total	

食用水果 Fruits	摄入量 Amount of intake (g)
1. 葡萄 Grapes	
2. 橘子 Tangerines	
3. 橙子 Oranges	
4. 苹果 Apple	
5. 猕猴桃 Kiwi	
6. 梨 Pear	
7. 桃子/油桃 Peaches	
8. 杏 Apricot	
9. 李子 Plum	
10. 草莓 Strawberries	
11. 柿子 Persimmon	
12. 鲜枣 Fresh dates	
13. 山楂 Hawthorn	
14. 香蕉 Banana	
15. 菠萝 Pineapple	
16. 西瓜 Watermelon	
17. 甜瓜 Melon	
18. 哈密瓜 Persian melon	
19. 葡萄干 Raisins	
20. 柿子干 Dried persimmon	
合计 Total	

100% 果汁 _____(ml)100% 蔬菜 汁 _____ (ml)

1/29/2004

水果蔬菜的分段计算调查表

注意:请被调查者填写每一个问题的答案

a. 通常你一天吃几份蔬菜和水果? (一份相当于半杯生的或熟的蔬菜, 一杯色拉, 一盘水果, 或 ¾ 杯 (6 盎司)100%纯度的果汁).

0 o	**1** o	**2** o	**3** o	**4** o	**5** o	大于等于 **6** o
↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓

(如果他/她对问题 A 的回答是“0”到“4”中的一个，请回答问题 B。)

↓

b. 你打算在接下来的 6 个月里每天吃 5 份或更多的水果蔬菜吗? 下面三个答案哪一个与你的想法最接近？（读每一个选项）

o	不, 你不打算在接下来的 6 个月里这样做。
o	是的，你打算在后面的 6 个月里这样做。
o	是的, 但是你只打算后面的 30 天里如此。

(如果他/她对问题 A 的回答是“5”或“大于等于 6”，请回答问题 C。)

↓

c. 你每天吃 5 份或更多的水果蔬菜超过 6 个月了吗？

o	不足 6 个月
o	超过 6 个月

Staging Algorithm for fruit and vegetable

PLEASE: Interviewee fill in each circle or box completely.

a. How many servings of fruits and vegetables do you usually eat each day? (a serving is ½ cup of cooked or raw vegetables, 1 cup of salad, a piece of fruit, or ¾ cup (6 ounces) of 100% fruit juice).

Zero o	**one** o	**two** o	**three** o	**four** o	**five** o	**six or more** o
↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓

(If he/she answers “zero” to “four” to question 1, go to question b.)

↓

b. Do you intend to start eating 5 or more servings of fruits and vegetables a day in the next 6 months? Which of these three answers best describe you? (Read each option)

o	No, you do NOT intend to in the NEXT SIX MONTHS.
o	Yes, you intend to in the NEXT SIX MONTHS.
o	Yes, you intend to in the NEXT 30 DAYS.

(If he/she answered “five” or “six or more” to question a., go to question c.)

↓

c. Have you been eating 5 or more servings of fruits and vegetables a day for more than 6 months?

o	Less than 6 months
o	More than 6 months