

# Investigating College Students' Diet and Physical Activity Behaviors Regarding Non-Communicable Diseases Prevention in China

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## Abstract

We aimed to investigate if college students' dietary and physical activity adhered to the Chinese Dietary Guidelines, the Composing Editorial Board of Physical Activity Guidelines, and WHO recommendation for NCDs prevention. **Methods:** A 3-day (2 weekdays and 1 weekend day) 24-hour (24-HRs) dietary recall was conducted to record details of participants' food consumption. One-way analysis of variance (ANOVA) was applied to examine the influence of the identified demographic variables (including BMI, gender, major, family monthly income, and place of household registration) on the 8 food groups' consumption. We analyzed the effect of the various demographic variables on sodium intake by the student's t-test. The questionnaire, International Physical Activity Questionnaire (IPAQ)-Short Form, was utilized to assess participants' physical activity (PA) level. The Wilcoxon-Mann-Whitney was applied to analyze participants' physical activity. **Results:** Our research indicated participants consumed much fewer fruits and vegetables and excessive meats on average for both males and females regarding NCDs prevention. **Conclusion:** Participants' dietary intake did not comply with the Chinese Dietary Guidelines recommendation for chronic diseases prevention. Nutrition knowledge and health education are needed for college students.

## Keywords

Non-Communicable Diseases, Dietary Behavior, Physical Activity, College Students

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## 1. Introduction

Non-communicable diseases (NCDs), referred to as chronic diseases, include diabetes, cardiovascular diseases, cancers, respiratory diseases, etc. NCDs often have prolonged conditions and need continuous medical attention. The diseases accounted for 41 million deaths per year worldwide, and deaths from NCDs have already exceeded communicable disease [1] [2]. According to WHO [2], the most affected countries and regions are low and middle-income countries. China, as a middle-income with a large population country, has been facing great challenge from NCDs. In-depth understanding and research on NCDs prevention and control in China is necessary.

In China, the number of NCDs-related mortality and disability has increased enormously since 1990 [3] despite the amount of effort, the government put in the diseases prevention and control [4] [5]. A rapid rise in NCDs has been reported in China. For instance, obesity, as one of the risk factors for NCDs, has become a serious public health problem in China. Based on the report from the China Chronic Disease and Nutrition Surveillance 2015-2019 [6], the prevalence rate of overweight and obesity was 34.3% and 16.4%, respectively, for adults aged 18 and older. The prevalence of diabetes increased from 0.67% in 1980 to 10.9% in 2013. The uprising trend of hypertension for Chinese adults increased from 18% in 2002 [7] to 23.1% in 2015 [8]. Chronic diseases in China among adults are as prevalent as in other countries in the world.

Studies indicated a great number of college students engaged in sedentary behaviors and unhealthy eating habits [9] [10] [11], which have been identified as two of the major risk factors for NCDs [1]. As we know, chronic diseases developed with time and could have started from a very young age. Hence, understanding college students' dietary and PA behaviors can facilitate disease prevention policies making and strategies formulation. Guangxi is a lunar province with lower family and individual incomes compared to other provinces in China. To our knowledge, there were little research exploring adults' dietary and PA behaviors regarding NCDs prevention in Guangxi province. Therefore, the purpose of our research was to investigate whether college students' food consumption and PA levels complied with the Chinese Dietary Guidelines, the Composing Editorial Board of Physical Activity Guidelines, and WHO recommendation regarding NCDs prevention.

## 2. Methods

A total of 122 healthy female and male students were recruited from a college in Guangxi province to participate in this study. Details of daily food intake were measured with a 3-day (2 weekdays and 1 weekend day) 24-hour (24-HRs) dietary recall method. The International Physical Activity Questionnaire (IPAQ)-Short Form was utilized to analyze students' physical activity (PA). Four undergraduate students from the university's Food Science Department received standardized training from a nutrition professor to assist with the implementation of

24-HRs dietary recall and IPAQ questionnaire interview.

### 2.1. Dietary Assessment: 3 Days 24-Hour Dietary Recall

The dietary interview was held at the university's food science lab, and trained research assistants were presented to assist in collecting interview data. Participants must report all the foods and beverages that were consumed in the past 24-HRs, from midnight to midnight, for a total of 3 days (2 weekdays and 1 weekend day). Photographs of portion size regarding different foods were provided as aids to help researchers correct dietary report. Students who consumed their meals from cafeteria or the street food stands near school would be asked to report the name of the dishes and restaurants in order for our research assistants to purchase the same dishes and to calculate their nutrition contents. The collected foods were categorized into eight food categories: cereals and tubers, fruits, vegetables, eggs, aquatic product, meat and poultry, soybeans and nuts, and milk and dairy products, in order to compare with the Chinese Dietary Guidelines which were often presented as Chinese Food Pagoda (CFP) (**Figure 1**). We compared students' actual dietary intake with CFP (**Figure 1**) and WHO [12] recommended Healthy diet.

### 2.2. Physical Activity Measurement: IPAQ Short Form

The IPAQ questionnaire, a widely used questionnaire to evaluate adults' (aged 18 - 65 yrs) PA, consists of two different forms, a long-form and a short form. The validities and reliabilities of the IPAQ questionnaire in different languages have been examined and the results were in disagreement [13]. However, report from Macfarlane D.J. *et al.*, [14] indicated that the IPAQ-short (IPAQ-SF) form was acceptable to use for Chinese adults, but caution is needed. Our study utilized the IPAQ-SF Chinese version, and the questionnaire was converted into an online survey which was available for all the participants. The IPAQ-SF contains



**Figure 1.** Chinese food pagoda.

9 items and measured four levels of activity including vigorous intensity, moderate intensity, walking, and sitting [15].

### 2.3. Statistical Analysis

Identified variables including participants' BMI, gender, major, family monthly household incomes, and place of household registration (rural or urban) were collected as they could affect students' eating habits. The One-way analysis of variance (ANOVA) was used to evaluate the influence of the above-mentioned variables on the intakes of the eight different food groups. To analyze students' sodium and milk intake, we performed student's t-test and Chi-square. The Wilcoxon-Mann-Whitney was applied to analyze participants' physical activity. The statistical software SPSS 26.0 was used for data analysis.

## 3. Results

### 3.1. Demographic Characteristics

A total of 122 students, 35 males (28.69%) and 87 females (71.31%), participated in this study. Details of their demographic information were shown in **Table 1**.

**Table 1.** Characteristics of the participants ( $N = 122$ ).

Characteristics	Number of participants ( $N$ )	Percent of participants (%)
Gender		
Male	35	28.69
Female	87	71.31
Major		
Food Science	57	46.72
Non-Food Science	65	53.28
Household Monthly Income		
Less than \$800	13	10.66
\$801 - \$1000	60	49.18
\$1001 - \$1500	39	31.97
More than \$1501	10	8.2
Place of Household Registration		
Rural	101	82.79
Urban	21	17.21
BMI		
Underweight	35	28.69
Normal	73	59.84
Overweight	9	7.37
Obese	5	4.1

### 3.2. Dietary Assessment: Comparison of the Actual Daily Food Intake with the Chinese Dietary Guidelines Recommendation

Results of our research indicated participants' daily food intake were not complied with the Chinese Dietary Guidelines recommendation (**Figure 1**) to prevent chronic diseases. Compared to the Chinese Dietary Guidelines (**Figure 1**), students consumed more cereals and tubers, meat and poultry, and soybeans and nuts. Meanwhile, they consumed much fewer vegetables, milk and dairy product, fruits, eggs, and aquatic products on average for both males and females. Details of the differences between the actual food consumption and the recommendation were presented in **Table 2**.

### 3.3. Dietary Assessment: The Relationship between the Identified Demo-Graphic Variables and the Eight Food Groups Consumption

The  $\chi^2$  test depicted a significant correlation between BMI and the intake of aquatic product group ( $p = 0.008$ ). Gender was strongly correlated with the intake of cereals and tubers ( $p = 0.003$ ), aquatic product ( $p = 0.009$ ), and meat and poultry ( $p = 0.048$ ) group; there was a strong relationship between students' major and eggs consumption ( $p = 0.032$ ).

### 3.4. One-Way ANOVA: The Effect of Identified Demographic Variables on Food Groups Consumption

We performed a one-way ANOVA to examine the effects of students' BMI, gender, major, family monthly income, and place of household registration on different food groups' consumption. Students' BMI had no influence on their food intakes of fruits, vegetables, eggs, meat and poultry, and soybeans and nuts groups. However, BMI showed significant differences on cereals and tubers ( $F(3, 118) = 3.485, p < 0.05$ ) and aquatic product ( $F(3, 118) = 3.708, p < 0.05$ ) consumption. Obese students ate more cereals and nuts and aquatic product compared to other students. Gender also exhibited great influence on the consumption of cereals and tubers ( $F(1, 120) = 28.464, p < 0.05$ ), aquatic product ( $F(1, 120) =$

**Table 2.** Comparison of the actual daily food intake with the Chinese dietary guidelines.

Food Groups (g)	Chinese Dietary Guidelines Recommendation	Actual Food intake (Male $N = 35$ )	Actual Food Intake (Female $N = 87$ )
Cereals and tubers	250 - 400 g	659.00	460.66
Meat and poultry	40 - 75 g	199.00	112.55
Soybeans and nuts	25 - 35 g	57.25	57.05
Vegetables	300 - 500 g	141.25	119.60
Milk and dairy product	300 g	90.62	37.15
Eggs	40 - 50 g	33.37	34.45
Fruits	200 - 350 g	89.08	137.66
Aquatic product	40 - 75 g	24.49	9.20

7.774,  $p < 0.05$ ), and meat and poultry ( $F(1, 120) = 21.066$ ,  $p < 0.05$ ). Compared to females, males consumed more on all food groups. Participants' academic major was another variable that affect participants' fruit intake ( $F(1, 120) = 5.640$ ,  $p < 0.05$ ); non-food science major students ate more fruits compared to food science major students. Family monthly income had no influence on any type of food consumption. For the place of household registration, students who were from urban cities consumed more eggs compared to those who lived in rural areas ( $F(1, 120) = 4.03$ ,  $p < 0.05$ ).

When analyzing different variables on milk and dairy product consumption, results from t-test indicated students who were obese, male, non-food science major, family monthly income 1000 to 1500, and lived in urban cities had higher milk and dairy product intake.

### 3.5. Comparison of the Average Daily Intake of Nutrients and the Recommended Amount Proposed by WHO

For fat consumption, both males and females met the WHO recommendation (no more than 30% of daily energy from fat) [12]. On average, females consumed 59.99 g of fat, and 74.93 g for males. For sodium intake, 74.6% of participants met the recommended amount that proposed by WHO, and 25.4% did not meet with the recommendation. Students' BMI, gender, major, family monthly income, and place of household registration had no influence on the amount of sodium intake.

### 3.6. Physical Activity

The results showed the median PA levels were 491.25 (MET min/wk), 300.21 (MET min/wk), 856.43 (MET min/wk), and 1647.91 (MET min/wk) for vigorous, moderate, walking, and total PA, respectively. The median sitting hours were 6.57 (h). Males were significantly more active than females. The non-food science major students had significantly higher PA levels than the food science students. For adults aged 18 to 64 years old, the physical activity guidelines for Chinese recommended 150 to 300 minutes of moderate-intensity or 75 to 150 minutes of vigorous-intensity per week [16]. Participants' levels of PA exceed the recommended PA (see **Table 3**).

**Table 3.** Physical activity measured by IPAQ short form ( $N=122$ ).

	Median	Mode	Maximum	Minimum	Percentage		
					P25	P75	IQR <sup>a</sup>
VPA <sup>b</sup> (MET min/wk)	491.25	0	12000	0	0	428	428
MPA <sup>c</sup> (MET min/wk)	300.21	0	3360	0	0	317.4	317.4
Walking (MET min/wk)	856.43	693.00	5544	0	235.62	1386	1150.38
TPA <sup>d</sup> (MET min/wk)	1647.91	1135.41	12240	0	396.00	2295	1899
Sitting (h)	6.57	6	20	0	4	8.13	4.13

<sup>a</sup>IQR: interquartile range = P75 - P25, <sup>b</sup>VPA: vigorous physical activity, <sup>c</sup>MPA: Moderate physical activity, <sup>d</sup>TPA: Total physical activity.

## 4. Discussion & Conclusions

Healthy diet and physical activity have been recognized as two of the most recommended factors for NCDs prevention [17]. However, participants in our research did not adhere to the Chinese Dietary Guidelines (**Figure 1**) and WHO recommendation [12] regarding chronic diseases prevention. They consumed much fewer vegetables, fruits and more meats, which could expose young adults to the danger of developing long-lasting diseases in the future. College is a transition period to develop independence and lifelong values. Their lifestyles established in this period of time could have a prolonged impact on their future. Therefore, students should receive knowledge and attitudes regarding adequate PA level and healthy eating habit.

As China remains its economic growth, the uprising trend of chronic diseases will continue due to social and environmental developments. To curtail the high prevalence of NCDs, Zhao *et al.* [4] suggested more investment should be in demand- and supply-oriented strategies. The demand-oriented strategies included government purchase, government service outsourcing, exercise demonstration, international communication, etc. while supply-oriented strategies were capital investment, public service, information support, institution construction, and so on [4]. Japan used to face great challenge from NCDs during its rapid economic growth era. Through establishing various of supporting strategies such as free health care package, long-term health insurance, and health promotion strategies (such as unhealthy lifestyles, specific health guidance, and so on), medical reforms, laws, and regulations, great progress and improvement has shown in Japan. Thus, Wu *et al.* [5] suggested that lessons could be learned from other nations like Japan which experienced similar epidemic status.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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