

Determinants of Fruits and Vegetable Intake Among International Students in China

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ABSTRACT

Background : Adverse health impacts of poor diet among the youth have become a subject of key concern for researchers and health professionals. Recently, studies proposed social norms and perceived as determinants of nutritional behavior among students. Empirical results from other literature evidenced the hypothesis that fruits and vegetable intake in students is affected by other perceived benefits. The objective of the study is to examine the role of social norms, perceived barriers and perceived benefits in fruits and vegetable intake among oversea students in China.

Method and Material : The subjects of the study include 411 foreign students in China with a structured questionnaire regarding perceived barriers, social norms and perceived benefits of fruits and vegetables intake. Hypotheses were practically tested and confirmed through Structural Equation Modeling.

Findings : The findings of the study show standardized estimates of the consumption of fruits and vegetable indicators among international students in China. Factor loading regarding path analysis clearly indicates that perceived barriers and social norms would cause a decline of fruits and vegetable intake while perceived benefits will help enhance fruits and vegetable intake.

Conclusion : The study concludes that, nutritional education programs targeting student groups should be encouraged for a positive behavior change and transformation of group norms and adherence to fruit and vegetable consumption.

Keywords: Fruits, Vegetables, Students, Structural Equation Modeling

I. INTRODUCTION

Eating habit is a crucial public health concern that has immense economic and health repercussions. Healthy eating habits are key players in the prevention of non-infectious diseases, particularly diabetes, cardiovascular diseases, cancer, Alzheimer's disease, and hepatic steatosis (Ryan et al., 2013). China, a home of many good universities globally, offering many opportunities for academic accomplishments and research work. Among the obstacles facing foreign students in China, nutritional issues are the most worrying. A report from the

ministry of education in China indicate that, China has significantly enhanced its performance in enrolling international students over 440,000 making a 35 percent increase surge from 2012.¹ Respectively, Asia is the star performer among the continents with majority of foreign students followed by Europe, Africa and Oceania. The continuous increase in number of overseas students in China is attributed to the economic- education collaboration between China and the other countries. China propelled the 'Belt and Road Initiative' in 2013 with the goal to

^a <http://en.moe.gov.cn/documents/statistics/2017/national/>

stimulate the economic and education relationship with Asian, African other European countries (Yang & de Wit, 2019).

Dietary habits are defined as the food consumption data which includes information about usual daily fruits and vegetable intake, eating pattern and usual nutrient intake which is considered as healthy or unhealthy (Park, Shin, & Song, 2019). The Transition period from home country to pursue education overseas is a critical period to understand the relation to dietary habits and health behaviors (Fazzino, Serwatka, Schneider, & Sullivan, 2019).

There is a worldwide consensus for dietary behavior change to halt the epidemic of chronic disease. World Health Organization, acknowledges that prevention instead of disease treatment is more effective in minimizing diet related diseases (Organization, 2010). Identifying dietary behaviors among students and identifying its determinants could be a foundation for designing effective intervention policy for encouraging healthful eating behavior among students.

Nutritional habits practiced throughout the university level could potentially be part and parcel of an individual's life, and can increase the chances of lifetime weight struggles accompanied with several health related health problems (Ganasegeran et al., 2012). In many instances, the university living environment exposed international students to unusual circumstances, including new friends and roommates Yakusheva, Kapinos, Weiss, and Biology (2011) accompanied with the struggle to maintain best nutritional practices. (Piernas & Popkin, 2010). Enhancing fruits and vegetable consumption in students is a very significant task with long-term potential health benefits nonetheless, certain factors interfere with its consumption among learners. Previous studies indicate that fruits and vegetable consumption habits are determined by a variety of

individual, social, and environmental factors of the given context (De Bruijn, 2010).

(Ghalaeh, Gholi, Bank, Azadbakht, & promotion, 2012) studied on the connections between the eating of fruits and vegetables, waists circumference and body mass index (BMI) among females students of Isfaha university in Iran. Their study identified a significant correlation between fruits and vegetables and BMI and body weight among the female students studied. Horacek et al. (2018) studied college students' eating behaviors, intentions and alongside weight status. Hollar, Paxton-Aiken, and Fleming (2013) examined the internal factors fruits and Vegetable consumption among fifth-grade students. Sidali, Pizzo, Garrido-Pérez, and Schamel (2019) studied the acceptability of insect intake in university students. Pelletier, Graham, and Laska (2014) assessed the interplay between perceived social norms and young adults' dietary behaviors for fruits and vegetable intake among college students. There seems to be a scarcity of research on international students' consumption of fruits and vegetable patterns in China in comparison with substantial studies conducted internationally. Considering the paucity evidence in China, the study aims to examine factors affecting fruit and vegetable intake of overseas students in China.

Three main hypotheses were looked at, which were;

- a. There is a significantly negative relationship between perceived barriers and fruits and vegetable intake and.
- b. There is a significantly negative relationship between subjective norms and fruits and vegetable consumption intake
- c. There is a significantly positive relationship between perceived benefits and fruits and vegetable consumption.

II. MATERIALS AND METHODS

2.1 Data collection

Data were extracted from 428 foreign students in Jiangsu University, China. The Institutional Review Board for Human Subjects of Jiangsu University approved the study protocol. The researcher requesting for permission to employ students to respond to the sample questions contacted professors on campus. After permission was granted, the researcher visited the various classrooms and laboratory centers of foreign students. Before proceeding to the main survey, participants read the consent form to and tick agreement to participate in the study. Inclusion criteria comprise all international students pursuing First degree, Masters and PhD of the various majors with ages 18 to 50years at the Jiangsu University. However, after two and a half weeks of the data collection, 17 questionnaires were excluded due to incomplete responses and for that reason, only 411 questionnaires were processed.

2.2 Measurements of construct

Dimensions employed by the study were adopted from previous studies. Although some literatures considered the items of dietary control scale together with the disinhibition scale Korinth, Schiess, and Westenhofer (2010) whiles Bevans, Sanchez, Teneralli, and Forrest (2011) adopted items from the

Children's Health inclining illness Profile to evaluate students eating. The study referencing Pelletier et al. (2014) modified and divided constructs into three parts, namely; perceived barriers, perceived benefits, social norms and fruits and vegetable consumption intake behavior as it has been shown to reliable and accurate. The first part of the questionnaire includes respondent's age, gender, educational level, residents and source of funding. The remaining four questions include five-point Likert Scale questions ranging from strongly disagree, disagree, indifferent, agree and strongly disagree. The study was pretested among fifty (50) international students in Nanjing South East University who were not part of the study experiments. The questions were reviewed and modified by the research team.

2.3 Statistical analysis

The statistical analysis of this study was performed using Statistical Package for Social Science (SPSS) version 21 software. This was used for, normality test, descriptive analysis, reliability analysis and Exploratory Factor Analysis (EFA). Confirmatory Factor Analysis (CFA) was conducted by using Analysis of Moment Structure (AMOS) version 21. with a Confidence level was set at 95%. AMOS is preferred over other analysis software since it is able to work effectively with sample size 200 and above.

Table 1 Demographic Profile

Variable Name	Item	Frequency	Percentage
Age	20-29	211	51.4
	30-39	111	27.1
	40-49	69	16.7
	50 and above	19	4.8
	Total	411	100
Gender	Male	262	63.8
	Female	149	36.2
Education	Bachelor	228	55.7
	Masters	72	34.3

	Phd	21	10.0
	Total	411	100
Source of Funding	Scholarship	247	60.0
	Self	164	40.0
	Total	411	100
Place of Residence	Off-campus	176	42.9
	On – campus	235	57.1
	Total	411	100

The demographic features of the study subjects are presented in Table 1. The 51.4% of the sample is, between ages 20-29, 27.1% are between 30-39 years, 16.7% are within 40 to 49 years and 4.8 are aged 50 and above. In addition, 63.8% of respondents studied comprised of males and females of 36.2%. With regards to level of education, 55.7% are undergraduate students, 34.3 are Masters Students, and 10% are pursuing their PhD. Moreover, 60% of the study subjects had the tuition fees funded by scholarships with the remaining students paying tuition fees by themselves. The majority of the students, 57.1% are living on campus and 42.9% stayed outside campus.

2.4 Data Suitability and Abnormality test for factor analysis

The study conducted Kaiser-Myer Olkin (KMO) coupled with Bartlett’s test to examine if data are suitable for factor analysis and to estimate sampling adequacy. The acceptable threshold for Bartlett’s test value is required to be less than 0.05 while KMO should be more than 0.5. Findings in Table 2 therefore shows variables are appropriate for factor analysis. Normality test of data was performed using Kolmogorov-Smirnova and Shapiro-Wilk normality test. The findings indicate variables are distributed normally with factors having significant values of less than 5%.

Table 2. Test of suitability and Normality results

Suitability Test					
		Results	Acceptable value		
	KMO	0.684	More than 0.5		
	Bartlett's Test	0.001	Less than 0.05		
			Shapiro-		
			Wilk		
	Kolmogorov-Smirnova				
		Sig.	Sig.	Statistic	Sig.
	FV	0.121	0.003	0.974	0.001
	PB	0.218	0.001	0.899	0.002
	PBN	0.178	0.004	0.945	0.001
	SN	0.169	0.002	0.901	0.002

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + (\sum Var(\epsilon_i))} \quad (1)$$

Here $(\sum \lambda_i)^2$ specifies construct loadings, while $(\sum Var(\epsilon_i))$ denote the summation of all construct error variance equal to one minus squared multiple covariance. Acceptable CR is expected to be above 0.7 an indication that, there are consistencies among the measures studied. In addition, obtaining good model in a study does not only settle the validity of the study (Bentler & Bonett, 1980) hence, it is relevant to perform convergent validity tests to examine correlation of the construct. Average variance extracted (AVE) was analyzed based on equation (2) as:

$$AVE = \frac{\sum_{t=1}^n \lambda_i^2}{\sum_{t=1}^n \lambda_i^2 + \sum_{t=1}^n \epsilon_i} \quad (2)$$

Here n indicate the number of items, λ_i^2 denotes construct loadings of item i loadings, while $\sum_{t=1}^n \epsilon_i$ represent variance of error items i .

The goodness of fit of the study model assessed include Degree of freedom (DF), Chi-square statistics (CMIN), CMIN/DF, comparative fit index (CFI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) (Garson, 2012). Garson (2012) indicated a threshold for estimating the goodness of fit. CFI is required to be greater than 0.95 RMSEA must be less than 0.06, PClose greater than 0.05, CMIN/DF between 1 and 3 while CMIN must be less than 0.5 to show a good fit

index. For evaluation of confirmatory factor analysis including the structural model, Chi-square statistics are estimated to be non-significant. However, some terms measured in the study include observed or reference variable, latent or Unobserved (latent) variable. Observed constructs are graphically displayed in squares while latent variables are shown by oval shape.

Convergent validity test Chin (1998) is performed to depict that hypothetically similar construct should be highly correlated with one another and with discriminant validity indicating dissimilar variables are to be less correlated or distinct from one another. Individual items reliability CR, Average variance extracted (AVE) and Cronbach's alpha estimation are presented to evaluate the convergent reliability. To ensure data validity, reliability test is conducted with the AVE denoting change in factors with composite reliability with Cronbach's alpha confirming the consistency of the data.

Table 3 depicts the results of measurement model of the individual items reliability in relation to the study variables ranges from 0.701 to 0.920 satiating the criteria specified (Hair, Anderson, Tatham, & Black, 1998). The composite value and the Cronbach Alpha and is greater than 0.7 also meeting the criteria proposed by (Awang, 2012). The AVE show values above 0.5 and thus satisfying the standard stated by (Hair et al., 1998).

Table 3. Item loadings and validities for reliability test and convergent validity.

Measurement Item	Factor Loadings	CR loadings	AVE values	Cronbach Alpha
Perceived Barriers				
I do not have enough money to buy fruits and vegetables	.882	0.888	0.725	0.891
Eating a fruit and vegetable will easily make me go hungry	.846			
Eating a fruit and vegetables will make me loss weight	.825			

Perceived Benefits

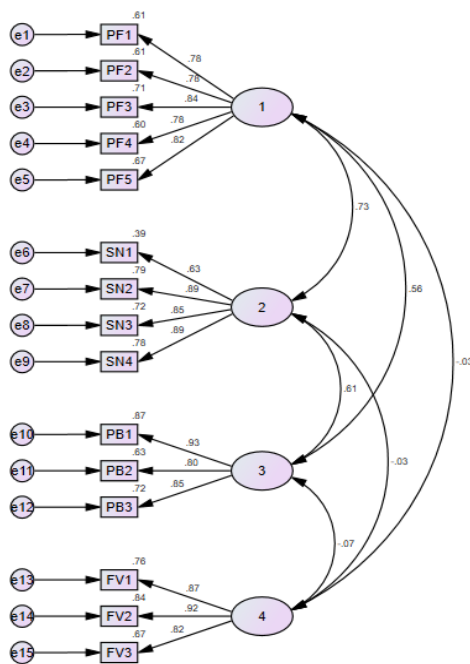
I feel eating fruits and vegetables a balance meal is good for my health	.818	0.848	0.583	0.899
When I take fruits and vegetables, my chances of facing health problems can be reduced	.822			
I feel psychologically better when I take a fruit and vegetable.	.701			
By eating fruits and vegetables of having constipation will be reduced	.705			
Eating a fruit and vegetable will help provide an important nutrient needed by the body				

Social Norms

It is normal for me to eat fruits and vegetables	.782	0.856	0.598	0.883
I eat fruits and vegetables because my friends encourage me to do so	.775			
I eat fruits and vegetables because important people in my life want me to do so.	.717			
I eat a fruit and vegetable to please my families	.817			

Fruits and vegetable consumption

I eat fruits and vegetables everyday	.920	0.938	0.835	0.903
I try new fruits and vegetables everyday	.928			
I eat more than two servings of a fruit and vegetable everyday	.893			



To confirm the goodness of fit of the extracted items, the confirmatory factor analysis (CFA) is also performed. Fig 1. depicts a graphical presentation of the output of the CFA.

Ignoring the presence of multicollinearity in structural equation modeling can lead to estimation bias. Therefore, discriminant validity is performed to check the measurement of the variables. Regarding this, the whole model without acknowledging endogenous or exogenous factors were presented with curve lines indicating covariances.

Fig 1. Confirmatory Factor Analysis

Table 4. Goodness of fit of the confirmatory factor analysis.

Measure	CMIN	DF	CMIN/DF	CFI	SRMR	RMSEA	PClose
Estimate	163.507	84	1.947	0.963	0.051	0.067	0.034
Threshold			Between 1 and 3	>0.95	<0.08	<0.06	>0.05
Interpretation	Excellent	Excellent	Excellent	Acceptable	Acceptable	Excellent	Excellent

A number of indices were employed to evaluate the overall values of the model (Table 4). Table 3. illustrate the goodness of fit of the data with the indices, meeting the expected criteria. From the findings, with 163.507 CMIN 68, DF 84, RMSEA 0.067, CMIN/DF 1.97, CFI 0.963, SRMR 0.051 with PClose of 0.034 hence the model of the study had a good fit and was acceptable.

Table 5 : Correlation Matrix

	F&V	PB	PBN	SN
F&V	0.913			
PB	-0.656**	0.851		
PF	0.632*	0.612**	0.763	
SN	-0.761**	0.518**	0.651**	0.733
Mean	3.670	4.103	3.936	4.160
Standard Deviation	0.674	0.710	0.731	0.720

Diagonals denotes the square root of AVE, * and ** represent 5% and 1% significant level.

Table 5 indicates the correlation matrix between fruits and vegetable intake, perceived barriers, perceived benefits and subjective norms in the study model. The findings confirm a negative connection between fruits and vegetable intake and perceived barriers whiles the social norms and fruit and vegetable consumption indicated a positive correlation.

1. Hypothesis Testing and results

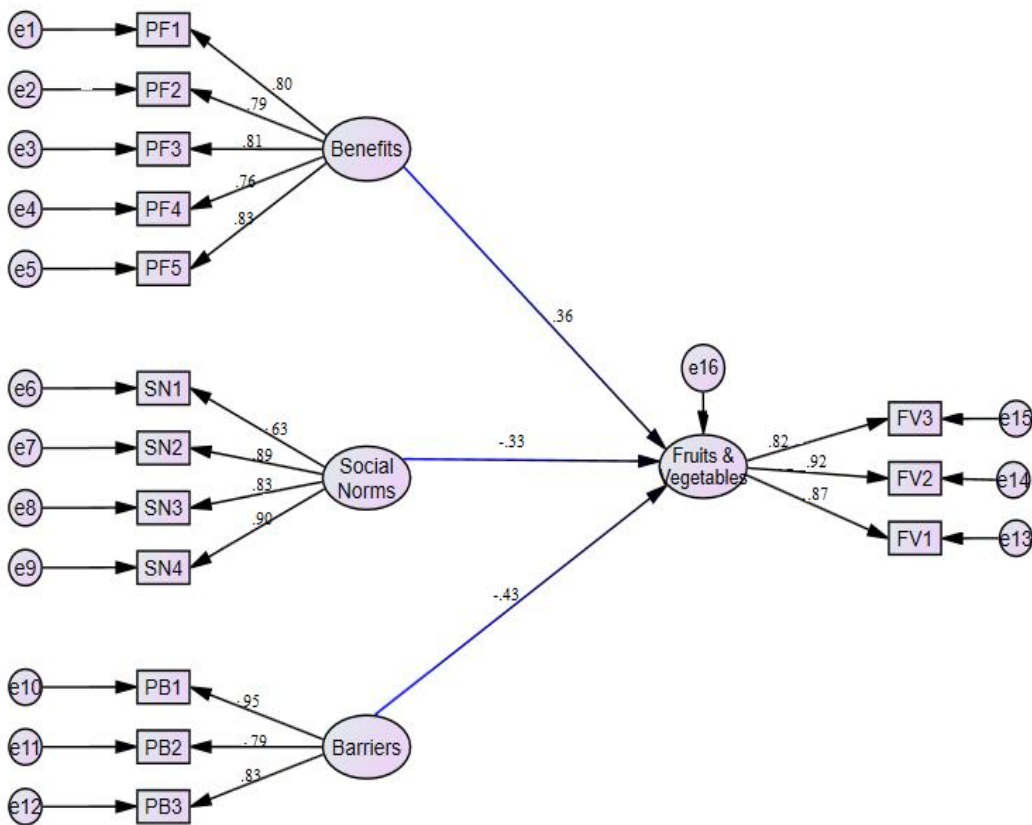


Fig 2. Path analysis depicting the connection between perceived barriers, subjective norms, perceived benefits and fruits and vegetable consumption intake.

The regression equations for the proposed model are shown in Fig. 2. The CMIN was found to be 169.9 with 89 DF, GMIN/ DF of 1.248, CFI 1.89 SRMR 0.031, RMSEA 0.025 and PClose of 0.092 representing how fit the model is.

Table 6. Standard estimates of Path Analysis.

Causal Path	Coefficient	C.R	P.value
Fruits and vegetable consumption intake ← Perceived barriers	-0.43	4.31	0.000*
Fruits and vegetable consumption intake ← Social Norms	-0.33	4.276	0.000*
Fruits and vegetable consumption intake ← Percieved Benefits	0.36	3.214	0.000*

III.CONCLUSION

Avoiding the intake of fruits and vegetable causes serious health consequences to human life, human beings, especially among students, there is an urgent

need to assess factors influencing the consumption. Consequently, the attention of nutritionist and health educators have shifted away from the intake red meat to the increase eating of fruits and vegetables. This study aims to consider the factor influencing the

intake of fruits and vegetables among oversea students in China.

The outcome of the indices defining the accuracy of the data revealed the study model meet the expected goodness-of-fit. The structural equation model reflects, how perceived barriers, perceived benefits and subjective norms affects the intake of fruits and vegetables. Thus, the findings of structural equation investigation support the assumption that perceived barriers and social norms negatively affects fruit and vegetable eating. Inversely, perceived benefits were positive.

Based on these findings the study has proposed some significant implications for public health experts. Nutritional education programs targeting student groups should be encouraged for a positive behavior change and transformation of group norms and adherence to fruit and vegetable consumption. The study again recommends that, individual counseling services must be provided for students to enable healthy fruit and vegetable choices. It is therefore suggested that, scope of upcoming studies should be expanded to include a larger sample size of international students from different universities in China.

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