

The Willingness to Adopt a Plant-Based Diet among Young Chinese Adults: A Mixed  
Method Study

by

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Thesis submitted in partial  
fulfillment of the requirements for the degree of  
Master of Science in the Global Health Program  
in the Graduate School of  
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2023

ABSTRACT

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## Abstract

Background: Chronic diseases have become a significant public health issue in China, accounting for nearly 88% of deaths and a considerable burden on healthcare resources. Among the various interventions to address this issue, adopting a plant-based diet (PBD) has gained attention for its potential health and non-health benefits. With its low intake of animal products, PBD has been associated with a lower risk of chronic diseases such as cardiovascular disease, type 2 diabetes, and certain cancers. In addition, PBD is also linked to benefits for the environment, animal welfare, and food security. Although young adults constitute a significant portion of the Chinese population, there is a research gap regarding their PBD consumption status and the factors that facilitate or impede their willingness to adopt this dietary pattern. Therefore, the goal of this study is to investigate the current PBD consumption status among young Chinese adults and the factors that influence their willingness to adopt this dietary pattern. Understanding these factors can help design effective interventions to promote PBD adoption among this population, potentially reducing the burden of chronic diseases in China.

Methods: This study utilized a mixed methods approach, incorporating both quantitative and qualitative data collection methods. The study was grounded in two health behavior models, the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM). The study population consisted of young Chinese adults aged between 18 and 35 years in 2022. A convenience sampling technique was used to recruit participants from various regions in China. Quantitative data were collected

by Wenjuanxing platform through a structured online survey, which aimed to describe the demographic characteristics of the participants, including age, sex, education level, income, and lifestyle. Additionally, the survey assessed participants' current PBD consumption status and willingness to adopt PBD. Qualitative data were collected through semi-structured interviews with a subset of the survey participants. The interviews aimed to explore in-depth the factors that influenced participants' willingness to adopt PBD, such as attitudes, subjective norms, perceived control beliefs, perceived benefits, perceived barriers, and cues to action.

Results: The survey data were collected from 495 participants, and the qualitative data were obtained from in-depth interviews with 29 participants. The study sample were evenly distributed across five geographical regions of China. The mean age was 27.03. The mean score of PBD index was 85.09. There were 256 out of 495 participants who had high PBD adherence. There was 94.95% of participants who had the intention to adopt PBD. With the adjusted model, people with intention to adopt PBD were more likely to have high PBD adherence than those without intention. Education attainment, marital status, disposable income, smoking, weekly exercise time and three different types of residence and eating habit significantly influenced participants' adherence to PBD. In terms of TPB and HBM, attitude, subjective norms are positively associated with participants' intention to adopt PBD, while perceived control beliefs, perceived benefits, perceived barriers, and cues to action are factors that are highly related with an individual's adherence to PBD.

Conclusions: This study provides valuable insights into factors influencing individuals' adoption of PBD in China. The findings reveal a high level of intention to adopt PBD and a significant association between intention and actual adherence to

PBD. Furthermore, the study identifies attitude, subjective norms, perceived control beliefs, perceived benefits, perceived barriers, cues to action as significant determinants of individuals' intention and adherence to PBD based on the TPB and HBM frameworks. The study underscores the importance of understanding the complex interplay of these factors that influence dietary behavior and highlights the need for public health policies that address these factors. These findings can inform the development of effective interventions and policies aimed at promoting PBD adoption in China and beyond.

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# 1. Introduction

The prevalence of chronic diseases, such as diabetes, hypertension, and cardiovascular disease, has been increasing globally. For instance, according to the International Diabetes Federation (IDF), the global prevalence of diabetes among adults (aged 20-79) was estimated to be 9.3% in 2019, which is equivalent to approximately 463 million people<sup>1</sup>. The trend of diabetes prevalence has been increasing globally over the past few decades. IDF estimates that the number of adults with diabetes will reach 700 million by 2045 if current trends continue<sup>1</sup>. The burden that diabetes and other chronic disease brought cannot be ignored. It is estimated that chronic diseases account for approximately 71% of all deaths and 74.5% of all disability-adjusted life years (DALYs) worldwide in 2019<sup>2,3</sup>. The burden of chronic diseases not only affects health but also has significant economic and societal costs. According to a report by the World Economic Forum and the Harvard School of Public Health, the global economic burden of NCDs is projected to reach \$47 trillion by 2030<sup>4</sup>. This includes \$16 trillion in lost economic output due to premature deaths and \$31 trillion in lost economic output due to disability<sup>4</sup>.

Chronic disease does not only bring burden to global but also affect China. In China, a study estimated that chronic disease burdens over the period 2010-2030 in China was approximately 7.74 trillion, or 3.42% of China's gross domestic product (GDP) during 2010-2030<sup>5</sup>. This includes both direct healthcare costs and indirect costs such as lost productivity. The economic burden of chronic disease in China remains a

significant challenge for the country's healthcare system and economy. Efforts to prevent and manage chronic disease is important for reducing this burden and improving health outcomes in China. Chronic diseases have been shown to be largely preventable through lifestyle changes, including a healthy diet<sup>6</sup>. Studies have shown that making healthy lifestyle changes, such as adopting a healthy diet, increasing physical activity, and quitting smoking, can help prevent and even reverse chronic diseases. For example, a study published in the New England Journal of Medicine found that lifestyle changes, including a healthy diet, can reduce the risk of developing type 2 diabetes by up to 58%<sup>7</sup>. Similarly, a study published in the Journal of the American Medical Association found that lifestyle changes can also help reduce the risk of heart disease<sup>8</sup>. Promoting healthy lifestyles and encouraging people to make positive changes can be an effective way to prevent chronic diseases and reduce the burden they place on healthcare systems and economies. For example, a study published in the journal Health Affairs estimated that a 1% reduction in the prevalence of obesity in the United States could save \$1.1 billion in medical costs<sup>9</sup>.

Poor dietary habits are a significant contributor to the burden of chronic diseases, including type 2 diabetes, heart disease, stroke, and certain types of cancer. A diet high in processed foods, added sugars, saturated and trans fats, and low in fruits, vegetables, whole grains, and lean proteins is considered a poor diet pattern and has been linked to increased risk of chronic diseases<sup>10</sup>. For instance, a diet high in added sugars has been shown to increase the risk of type 2 diabetes and heart

disease. A study published in the Journal of the American Medical Association found that people who consumed more than 25% of their daily calories from added sugars had a significantly higher risk of dying from cardiovascular disease compared to those who consumed less than 10% of their daily calories from added sugars<sup>10</sup>. On the other hand, a diet rich in fruits, vegetables, whole grains, and lean proteins has been shown to help prevent and manage chronic diseases. For example, a study published in the journal Diabetes Care found that a plant-based diet rich in whole grains, legumes, fruits, and vegetables helped improve blood sugar control in people with type 2 diabetes<sup>11</sup>.

There is evidence suggested that the prevalence of unhealthy eating is on the rise among younger populations<sup>12</sup>. Young adults often consume high amounts of processed and fast foods that are high in fat, salt, and sugar, while lacking essential nutrients such as vitamins, minerals, and fiber<sup>13</sup>. These unhealthy dietary habits can lead to an increased risk of chronic diseases and associated complications later in life, such as heart disease, stroke, and certain types of cancer<sup>14,15</sup>. A systematic review and meta-analysis published in The Lancet in 2019 examined the relationship between dietary factors and non-communicable diseases (NCDs) and found that unhealthy dietary patterns (defined as diets high in red and processed meat, sugar-sweetened beverages, refined grains, and low in fruits, vegetables, whole grains, nuts, and seeds) were associated with an increased risk of all-cause mortality, as well as specific NCDs including cardiovascular disease, cancer, and type 2 diabetes<sup>16</sup>. It is essential to understand the factors contributing to the increasing prevalence of

chronic diseases to develop effective prevention and management strategies.

The habits formed in young adulthood often extend into later adulthood, resulting in short and long-term health outcomes. A study followed a cohort of young adults for 20 years and found that those who had poor diets in early adulthood were more likely to have poor diets in middle age, and were also more likely to develop chronic diseases, such as diabetes and hypertension<sup>17</sup>. This is particularly concerning given that unhealthy behaviors are often difficult to change once they become entrenched<sup>18</sup>. Studies have shown that individuals who adopt healthy behaviors, such as PBD, at a young age are more likely to maintain these behaviors in the long term and enjoy improved health outcomes<sup>19</sup>. According to research, young adults who become more independent tend to make less healthy dietary decisions<sup>20</sup>. Their typical choice for diet consists of foods that are high in fat, sugar, and salt<sup>21</sup>, and consumption of plant-based foods like vegetables and nuts typically falls short of dietary recommendations in China<sup>22</sup>. Young adults in China also have a tendency to eat a lot more meat than is advised<sup>23</sup>, which is problematic because popular processed meat and red meat are salty and heavy in saturated fat<sup>24</sup>. Therefore, it is crucial to promote healthy lifestyle behaviors, such as PBD, among young adults in order to reduce the burden of chronic diseases and improve overall health outcomes. By adopting a healthy diet on young adults can prevent the onset of chronic diseases and associated complications and enjoy better health and quality of life in the long term<sup>25</sup>.

Plant-based diets (PBD) is a diet that emphasizes the consumption of foods

derived from plants, such as fruits, vegetables, legumes, whole grains, and nuts, and minimizes the consumption of animal products, which represents a growing trend in the promotion of both human and environmental health<sup>11,26,27</sup>. PBD has positive effect on human health. There is an increasing body of research evidence showed that plant-based diets were associated with significant reductions in risks for developing non-communicable diseases (NCD) like heart diseases, diabetes, and cancer<sup>28-32</sup>. The evidence from clinical trials has shown that PBD could help reduce blood pressure when compared with omnivorous diets. This suggesting that plant-based diet may be crucial in the primary prevention and overall management of heart disease and hypertension. Recent research also found that PBD may help decrease risk of type II diabetes (T2D)<sup>33</sup>, indicated that higher adherence to PBD is associated with lower longitudinal insulin resistance, and lower risk of prediabetes and T2M. Besides, another study found that greater consumption of PBD was associated with a lower risk of fatal prostate cancer<sup>34</sup>.

Promoting the production of plant-based food also contributes to environmental health, as it helps lower levels of greenhouse gas emissions compared to those of raising animals for human consumption<sup>35,36</sup>. As livestock significantly contributes to greenhouse gas emissions, reduced consumption of animal products in favor of PBD holds the promise of being more environment-friendly<sup>35</sup>. Resource consumption would also decrease with meat products reduction. Less resource exploitation and environmental destruction will reduce the cost of climate change mitigation. There is an increasing awareness of sustainable lifestyles around the



world<sup>36</sup>. The public has started to focus on improving health of both human and nature. Sustainable Development Goals (SDGs) including Global Health and Well-being, Responsible Consumption and Production, Climate Action are related with the change of global food system to achieve these objectives<sup>37</sup>. Among which, PBD is one of the vital components to promote sustainable development. The change of diet will have beneficial impact on human health and can also reduce greenhouse gas emissions and animal welfare. These positive impacts are important for the fulfillment of several SDGs.

The prevalence of plant-based diets varies by region and population, but there is growing interest in these diets worldwide. Regarding the prevalence of PBD, a study published in the journal *Nutrients* examined the dietary patterns of over 10,000 adults in the United States and found that approximately 10% of the sample followed a plant-based diet<sup>19</sup>. However, the prevalence of PBD in China is still unclear, even though the country has a long history of plant-based cuisine. Given China's population size and its impact on global food systems<sup>38</sup>, it is crucial to understand the prevalence of PBD in China to obtain a more comprehensive picture of this dietary patterns of the world. Few studies have investigated this topic among Chinese population. To achieve this goal and promote PBD among Chinese population, it is crucial to investigate the prevalence of PBD in China and provide insights into the factors that influence this dietary choice.

To develop effective interventions to promote adoption of PBD, understanding what the factors contribute to PBD is significant. Attitude, subjective

norms, perceived control beliefs (concepts from Theory of Planned Behavior, TPB), perceived benefits, barriers and cues to action (concepts from Health Belief Model, HBM), have proven to influence people's intention and action. TPB states that intention, which is the immediate antecedent of behavior, and is influenced by attitudes, subjective norms, and perceived behavioral control. TPB has shown to be a highly helpful framework to qualify the intention toward health behaviors, offering pertinent information on how to promote healthy choices, including healthier eating choices (PBD) among targeted population<sup>39</sup>. The intention to adopt PBD does not often turn into action directly. Other factors, such as perceived barriers, perceived benefits, and cues to action<sup>40</sup>, which were showed in the Health Belief Model (HBM)<sup>41</sup>, can all influence the relationship between intention and actual adoption of PBD. The HBM is widely used in health education and health promotion programs as it provides a framework for understanding how individuals make decisions about their health and how health behavior can be changed<sup>42</sup>. By addressing the perceived benefits, barriers, and cues to action, future health educators and health promotion campaigns can increase the likelihood that individuals will engage in healthy dietary pattern (PBD). These two frameworks are now the most well-known strategy which can influence intention and behavior change<sup>39,43-45</sup>. Research used TPB and HBM to explore the targeted population's healthy eating intention and behavior<sup>46</sup>. In essence, it is believed that intentions are the primary predictors of any behavior, and intentions are in turn influenced by these predictive factors<sup>47</sup>. These two models are served as the theoretical framework for this study, which sought to examine young

Chinese generation's intentions to adopt PBD<sup>1</sup>.

Therefore, this mixed methods study based on TPB and HBM aims to 1) examine the prevalence of high PBD adherence, and 2) explore the factors that facilitate or impede the adoption of PBD among the young adults in China. The findings of this study have the potential to inform policy and public health interventions aimed at promoting PBD adoption among young adults in China. For instance, the study may help identify the key factors that influence young adults' decision to adopt PBD, such as perceived benefits and barriers, subjective norms, and cues to action. This information could be used to design tailored interventions that address these factors and promote the adoption of PBD. Additionally, the study may provide valuable insights into the social and cultural factors that influence PBD adoption in China, which could inform the development of culturally appropriate interventions.

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<sup>1</sup> Footnote: Attitude refers to a person's positive or negative evaluation of the behavior to adopt PBD. Subjective norms refer to the perceived social pressure or influence from significant others such as family, friends, colleagues. This reflects an individual's perception of whether those around them would approve or disapprove of their behavior, and the extent to which they feel obliged to comply with the expectations of their social group. Perceived belief control refers to people's perceived ability to find and prepare plant-based meals, as well as their perceived ability to resist the temptation to consume non-plant-based foods. Research had found that TPB significantly predicted intention to adopt PBD, and intention, in turn, significantly predicted actual behavior<sup>48</sup>. Perceived benefit refers to an individual's belief that engaging in a particular health behavior will lead to positive outcomes, such as improving health or preventing illness. Perceived barriers refer to an individual's belief that engaging in a health behavior will be difficult, time-consuming, expensive, or unpleasant. Cues to action refer to factors that prompt an individual to engage in a health behavior, such as reminders, advice from a healthcare professional, or exposure to health-related information.

## **2. Method**

This mixed method study used online survey and in-depth interview to collect both quantitative and qualitative data. This study was approved by the Institutional Review Board of Duke Kunshan University (2022ZQ019).

### ***2.1 Study Population and Sampling***

Eligible participants in this study are young adults aged between 18-35 years old and live in China, regardless of their sex, geolocation, race, education, and socioeconomic status. The participants for this anonymous online questionnaire survey were recruited by Wenjuanxing platform, which is an online survey platform commonly used in China, by using convenient sampling to collect data. To recruit the eligible interview, In the online questionnaire, participants could leave their contact information if they were willing to attend the qualitative interviews. The inclusion criteria were age limitation and habitual residence.

### ***2.2 Data collection***

#### **2.2.1 Online questionnaire**

The online anonymous survey was developed to examine the status of PBD adoption among young adults in China. The survey includes 4 major domains: demographics, lifestyle, intention to adopt PBD and dietary intake. Demographic information consisted of gender (male, female), age (18-35), place of residence

(including current, native and permanent residences), race, marital status, education, disposable income, working hour. Lifestyle included exercise, daily routine, TV/video watching, smoking, drinking. In the context of a study examining the adoption of PBD, a binary score of 0/1 was used to determine each participant's intention to adopt PBD. The score of 0 indicated no intention to adopt a PBD, while the score of 1 indicated an intention to adopt a PBD.

Dietary intake behavior was collected by using a semiquantitative food-frequency questionnaire (FFQ), which has been developed at Harvard University<sup>49</sup>. There were 18 questions includes a list of foods and beverages, including whole grains, fruits, vegetables, nuts, legumes, vegetable oils, tea, coffee, fruit juices, sugar sweetened beverages (SSBs), refined grains, potatoes, sweets, butter/lard, dairy, egg, fish/seafood, meat, and other foods derived from animals. Respondents were asked to choose the frequency of consumption. Participants used 9 response categories, ranging from "never or less than once/month" to "6 times per day," to indicate how frequently they had consumed defined portions or the serving size of each food or beverage from around 130 food categories with in 18 questions on average over the preceding year<sup>2</sup>.

Further, the PBD index score was defined using the FFQ by Satija et al<sup>19</sup> to categorize the participants in terms of their PBD adherence. Eighteen food groups were created in semiquantitative FFQ according to their nutritional composition and flavor profiles within the broad categories of healthy plant foods (whole grains, fruits, vegetables, nuts, legumes, vegetable oils, tea, and coffee), unhealthy plant

foods (fruit juices, SSBs, refined grains, potatoes, and sweets), and animal foods (butter/lard, dairy, egg, fish/seafood, meat, and other foods derived from animals) (Appendix). As a diet index which positively weighs plant foods while negatively weighing animal foods. This index can be used to weigh how much plant food people consumed. Positive or negative scores were assigned to each food group's consumption. With the criteria of positive score, participants who consumed the highest portion of a food group received a score of 9, while those who consumed the least portion received a score of 1. While, in reverse score criteria, participants who consumed the highest portion of a food group received a score of 1, while those who consumed the least portion received a score of 9. Therefore, the scores for 18 food groups were added to create plant-based index (PBI). Healthy plant food group and less healthy plant food group were given positive scores, and animal food group was assigned with reverse score. Summing 18 food groups for PBI, the score range was 18-162.

To determine each participant's level of adherence to a PBD, a median score 85 among the participants was used as a cut-off<sup>51</sup>. This cut-off allowed for the categorization of each participant as having low or high PBD adherence based on their diet behavior. This approach allows for the identification of individuals who actually adopt a PBD and those who are less likely to do so based on their self-reported dietary behavior<sup>51</sup>.

## 2.2.2 Qualitative interview

This in-depth interview based on the TPB and HBM framework<sup>52</sup> was conducted to explore what are the facilitators and barriers for young Chinese adults to adopt PBD. Due to covid-19 pandemic, online and off-line interviews were combined to collect qualitative data. For off-line interviews, a separate, quiet room were used to conduct one-on-one, semi-structured interviews and focus group discussions (30-60 minutes). For online interviews, Zoom was used to conduct interviews. In June and July 2022, interviews were recorded by using digital voice recorder.

These beliefs typically relate to: (1) the young Chinese generation' s attitude toward adopting a more plant-based diet (e.g., asking “What is your attitude to PBD? Do you think it is beneficial for your health?”); (2) subjective norms: motivation to comply with perceived social norms relating to the adoption of PBD (e.g., asking "Do you think it is important to have same dietary pattern with your friends or families?"); (3) perceived control belief, self-efficacy with adopting PBD (e.g. asking “Are you confident in adopting PBD if you want to make a change to your diet pattern?). Additionally, perceived benefits, perceived barriers and cues to action were discussed open-ended in group discussions. Other potential factors that would influence participants’ adoption of PBD were also discussed during interviews.

To explore potential moderator for people’s adoption of PBD, individual characteristic was also asked, such as social characteristics (including education and culture), or informational characteristics (media outreach and knowledge). Therefore,

during interviews, mediators were also discussed to gain a deeper understanding of how they may impact the predictive factors being studied.

All interview subjects received advance information about the study's objectives and gave written consent. All participants were informed that interviews would be recorded and transcribed. They were also informed that data would be managed confidentially by being stored on a password-protected system that was only available to the researchers who were directly engaged.

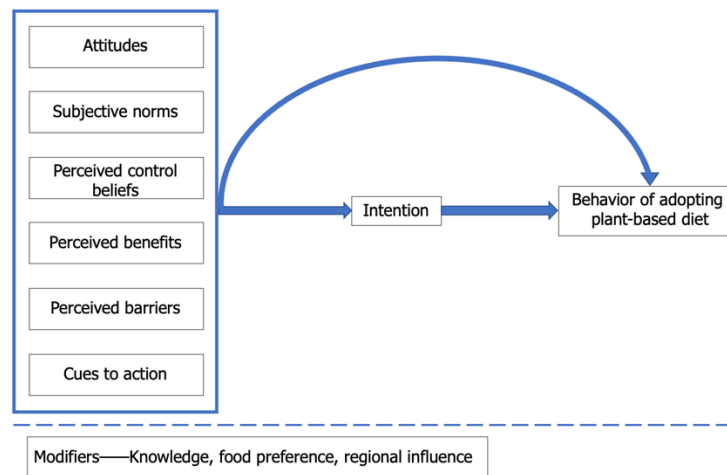
### **2.3 Data analysis**

Descriptive table represented the characteristics of the targeted population, including demographics, lifestyle, intention to adopt PBD and dietary intake mean of PBD score and percentage of participants who followed PBD. ANOVA was used to test whether there were significances between young Chinese generation's PBI (continuous variable) and demographic characteristics and different types of regions. Further, adjusted model was also conducted to eliminated confounders' influence on people's PBD behavior. Logistic regression was utilized to examine the correlation between people's intention with PBD adherence (binary variable). Analyses were performed by Stata17, (StataCorp), and statistical significance was set at P value <0.05.

To analyze the qualitative interview data, it was first translated by iFlytek, which is a Chinese technology company that specializes in artificial intelligence and natural language processing, provide services related to voice recognition, speech



synthesis, and machine translation. And then the text data was imported to NVivo software (Nvivo 12, QSR International) to conduct thematic analysis. The creation of a pre-structured coding scheme was based on the study hypothesis framework (Fig 1). For other significant themes that were derived from the data and did not fit with existing codes, additional flexible codes were employed. For this publication, the interviews and analysis were carried out in the Chinese language and the transcriptions of the recordings were translated into English.



**Figure 1. Theory of Planned Behavior and Health Belief Model**

## **3. Result**

### ***3.1 Characteristics of participants***

A total of participants in the survey was 504. After screening, 495 remained.

The screening process was implemented to ensure that the data collected was of high quality and reliable. During the screening process, responses with missing key information or incomplete answers were excluded. There were 29 participants in qualitative interviews. Among them, 18 were females and 11 were males; 6 from north, 6 from east, 5 from central, 6 from southwest, and 6 from south.

Characteristics of the survey participants are summarized in Table 1. Among the participants, about half of them were female, married. The mean age of participants was 27.03 years old, ranging from 18 to 35 years old. Among the participants, most about three quarters participants attained undergraduate education, had more than 5k RMB disposable income monthly, had regular working hour, and self-reported no religion affiliation. Regarding to lifestyle, more than a half of participants either smoking or drinking, had more than 2.5-hour exercise time weekly and regular daily routine.

The mean score of PBI score was 85.09. Education attainment, marital status, disposable income, smoking, weekly exercise time and three different types of residence and eating habit significantly were associated with participants' PBD index. Higher education, higher income, marriage, less drinking and smoking generally led to higher score in PBI score. Meanwhile, based on the median PBI score

85 as a cutoff, 52% of participants (n=256) were categorized as high PBD adherence. Similarly, sex, age, marital status, disposable income, smoking, drinking, and eating habit all represented significant impact on the high adherence to PBD (Table 2). Female, higher income, marriage, less drinking and smoking generally led to high PBD adherence.

It hypothesized that the current permanent and native residence may relate to PBD behavior. The results showed that all the three types of residence were significantly related to PBI score and shared similar trend: participants resident in north region were likely to have higher score, while the participants in south region were likely to lower score (Table 3). Sensitivity analysis showed that 94.79% and 94.87% of participants currently live in the same geographic location as their permanent or native residence, respectively. Therefore, current residence was used as the inclusion criteria to recruit national-wide sample for the qualitative interviews.

**Table 1. Characteristics of participants (n=495)**

Characteristic	Participants included in this analysis	
	N	Percent
Sociodemographic		
Sex		
Male	231	46.67
Female	264	53.33
Educational attainment (495)		
Less than high school (12th grade with no diploma)	13	2.63
Junior college education	34	6.87
Undergraduate	381	76.97
Master or above	67	13.54
Marital status		
Single	145	29.29
In love	77	15.56
Married	272	54.95
Divorced	1	0.20
Disposable Income		
Less than 2k RMB	46	9.29
2k-5k RMB	131	26.46
5k-1w RMB	205	41.41
1w-2w RMB	96	19.39
More than 2w RMB	17	3.43
Regular working hour		
No	57	11.52
Yes	363	73.33
Working hours		
Less than 40h/week	113	22.83
40-54h/week	277	55.96
More than 54h/week	30	6.06
Religion		
No	444	89.70
Yes	30	6.06
Lifestyle		
Weekly exercise time		
No exercise	52	10.51
Less than 2.5h	180	36.36
More than 2.5h	263	53.13
Regular daily routine		
No	90	18.18
Yes	330	66.67

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Smoking		
No	370	74.75
Former smoker	57	11.52
Current smoker	68	13.74
Drinking		
No	374	75.56
1-3 times/week	108	21.82
4-6 times/week	11	2.22
Everyday	2	0.40
Watching electronic devices (phone, pad) while eating		
No	43	8.69
Sometimes	199	40.20
Often	193	38.99
Every time	60	12.12
Geolocation		
Current location		
North	105	21.21
East	95	19.19
Central	92	18.59
Southwest	99	20.00
South	99	20.00
Native location		
North	119	24.04
East	97	19.60
Central	94	18.99
Southwest	94	18.99
South	85	17.17
Permanent residence		
North	111	22.42
East	115	23.23
Central	78	15.76
Southwest	92	18.59
South	97	19.60
Intention to adopt PBD	470	95.00
Age group		
18-25	147	
25-30	207	
30-35	141	
Age	Mean (SE) 27.03	Median 27

PBD index 85.09 85.00

Abbreviations:

PBD: Plant-based diet

High PBD adherence: PBD index more than 85

**Table 2. PBD index and adherence of participants**

Characteristic	Total participants (n=495)		High PBD adherence (n=256)		
	PBD index* (mean)	P	N	Percent	P
<b>Sociodemographic</b>					
<b>Sex</b>					
Male	84.48	0.087	107	41.80	0.025
Female	85.62		149	58.20	
<b>Educational attainment (495)</b>					
Less than high school (12th grade with no diploma)	85.46	0.064	5	2.00	0.19
Junior college education	82.94		14	5.42	
Undergraduate	85.54		207	80.86	
Master or above	83.57		30	11.72	
<b>Marital status</b>					
Single	83.21	0.0002	59	23.05	0.0002
In love	84.73		33	12.89	
Married	86.28		164	64.06	
Divorced					
<b>Disposable Income</b>					
Less than 2k RMB	81.61	0.0003	16	6.25	0.0080
2k-5k RMB	84.10		58	22.66	
5k-1w RMB	85.48		112	43.75	
1w-2w RMB	87.02		60	23.44	
More than 2w RMB	86.53		10	3.91	
<b>Regular working hour</b>					
No	85.05	0.57	31	13.60	0.99
Yes	85.64		197	86.40	
<b>Working hours</b>					
Less than	85.94	0.56	66	28.95	0.46

40h/week					
40-54h/week	85.54		148	64.91	
More than 54h/week	84.33		14	6.14	
Religion					
No	84.94	0.35	226	88.28	0.22
Yes	86.87		20	7.82	
Lifestyle					
Weekly exercise time					
No exercise	84.08	0.0003	25	9.77	0.094
Less than 2.5h	83.57		83	32.42	
More than 2.5h	86.33		148	57.81	
Regular daily routine					
No	85.18	0.57	46	20.18	0.50
Yes	85.67		182	79.82	
Smoking					
No	84.68	0.033	181	0.70	0.010
Former smoker	87.37		40	0.16	
Current smoker	85.40		35	0.14	
Drinking					
No	84.87	0.57	185	72.27	0.010
1-3 times/week	85.83		64	25.00	
4-6 times/week	85.82		7	2.73	
Everyday	81.5				
Watching electronic devices (phone, pad) while eating					
No	85.77	0.0041	24	9.38	0.037
Sometimes	84.50		95	37.11	
Often	86.28		113	44.14	
Every time	82.70		24	9.38	
Geolocation					
Current location					
North	87.16	0.0066	63	24.80	0.32
East	84.25		45	17.72	
Central	85.73		50	19.69	
Southwest	84.07		48	18.90	
South	84.09		48	18.90	
Native location					
North	86.79	0.025	73	28.74	0.20

East	84.97		47	18.50	
Central	85.27		48	19.90	
Southwest	83.83		44	17.32	
South	84.04		42	16.54	
Permanent residence					
North	87.14	0.0052	68	26.77	0.11
East	84.37		53	20.87	
Central	85.62		43	16.93	
Southwest	83.75		42	16.54	
South	84.22		48	18.90	
Age group					
18-25	83.64	0.016	60	23.44	0.0063
25-30	85.59		116	45.31	
30-35	85.86		80	31.25	

Abbreviations:

PBD: Plant-based diet

High PBD adherence: PBD index more than 85



### 3.2 PBD intention and behavior

Ninety-five percent of survey participants (n=470) who had the intention to adopt PBD. Similarly, majority of interview participants (n=27, 93.10%) also showed a relative clear intention to adopt PBD in interviews. Logistic regression showed that people with intention to adopt PBD were 2.89 times higher odds have high PBD adherence than those without intention. Participants in qualitative interviews expressed that they were willing to try eating more vegetables, grains, and other plant-based food, as well as reducing meat products. And they were categorized as high PBD adherence, as their PBI score were ranged from 79 to 95.

**Table 3. Logistic regression model of intention for high PBD adherence among all participants**

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
No intention	Ref	Ref
With intention	3.60 (1.41, 9.17)	2.89 (1.10, 7.66)

\* Adjusted model: adjusted for gender, different types of residences, age, exercise time, disposable income, marital status, eating habit drinking, smoking and religion status

### **3.3 Factors that influence the intention to adopt PBD**

#### **3.3.1 Attitude**

Regarding to the attitudes of participants in interviews, 19 of them (65%) expressed positive attitude towards PBD as they believed it would be beneficial to their health. Some of them think PBD will improve health to themselves, or environmental health, as said by: "I think I have positive attitude to PBD because it is beneficial for my health" or "I am also positive to PBD because it may be helpful to the environment". Five of total (18%) showed negative attitude to try this diet pattern because they did not believe PBD would bring any advantage to them. For instance, some of them said: "I hold negative attitude to PBD because I do not think I will take advantages from it." Rest of them (17%) said that they hold neutral attitude to PBD, as said: "I do not have any attitude for PBD. I just did not pay attention to diet."

Among the participants with positive attitude, all of them (n=19) expressed intention and 90% of them had high adherence to PBD. Among participants with negative attitude, two participants (2 out of 5) did not have the intention to adopt PBD, and their PBD scores were around the mean score 85, 40% had high PBD adherence. Among the participants with neutral attitude, the result shared the same trend with participants holding negative attitude. Three of five have the intention to adopt PBD and their PBI score were around the mean score.

### 3.3.2 Subjective norms

The results indicated that 50% of the participants (n=15) reported that they had friends and family members who follow PBD. Among them, 73% of participants (n=11) stated that they would choose to follow the same pattern as their friends and family members and adopt a PBD. They perceived their friends and family members' behavior as approval towards following the diet and saw it as a way to strengthen their relationship with them. For instance, one participant stated, "Some of my friends and family follow PBD, and I would like to follow the same pattern as I usually have meals with them." On the other hand, four out of 15 participants (27%) reported that they knew friends who follow PBD, but it would not make any difference in their dietary choices. They perceived their friends and family members' behavior as disapproval towards following the diet and did not see it as a motivating factor to adopt PBD. For example, a participant reported, "I do know some friends who follow PBD, but it will not make any difference in my dietary choice." Another half some participants (n=14) reported that they did not have friends or family members who follow PBD. Among them, some participants (n=7) stated that they would choose not to adopt PBD, and they perceived their friends and family members' behavior as approval towards not following the diet. For example, one participant said, "I barely know anyone who adopts PBD, and me neither." However, other participants (n=7) stated that even they did not have friends or family members who follow PBD, but their behavior did not influence their own dietary choices. They perceived their friends and family members' behavior as disapproval towards

following the diet. For instance, one participant stated, "I do not know any family member or friends who follow PBD, but their dietary habits did not influence mine."

Moreover, the TPB suggests that the strength of subjective norms can vary depending on the source of influence. One interviewee expressed that the perceived opinion of a close family member or friend may carry more weight than that of a distant acquaintance. This may indicate that the influence of subjective norms may be stronger when the source of influence is perceived to be closer or more significant in the individual's life.

Among the participants who reported having friends and family members approve PBD and comply with them (n=15), all of them had the intention and 86% high adherence to PBD (n=13). Among the participant who reported having their family and friends approved PBD but did not comply with them (n=8), half of them had the intention to adopt PBD and 25% of them had high PBD adherence. Among the participants whose friends or family members disapprove PBD, and they comply with them, 70% of them had the intention to adopt PBD and 28% of them had high PBD adherence. Among the participants whose friends or family members disapprove PBD, and they did not comply with them, all of them had the intention to adopt PBD and 57% of them had high PBD adherence.

### **3.3.3 Perceived belief control**

There were 62% (18/29) participants showed that they are not confident in adopting PBD pattern. They said that due to lacking confidence in their ability to

cook for themselves, they have limited control over their food choices. Eleven participants (38%) expressed that they were confident in controlling over their food choices as said that they can cook for themselves. Some of them said: "I do have such confidence that I can change my diet pattern (to PBD), because usually I cook for myself."

Among the participants who expressed a lack of confidence in adopting PBD 90% of them had the intentions to adopt PBD. While their adherence to a PBD were not high, only half of them had high PBD adherence. All participants who had high perceived control beliefs had the intention to adopt PBD and they were all categorized as high PBD adherence.

### **3.3.4 Perceived benefits**

The perceived benefits of PBD include improved health outcomes, and environmental sustainability.

The majority of participants (86%, n=25) mentioned that richness of nutrients in PBD was associated with their decision to adopt PBD. Interviewees were aware of various benefits that PBD could bring to health. They knew that PBD are often rich in fiber, which can help promote regular bowel movements and prevent constipation. One participant (female, 24) also mentioned that: "I think PBD is easier to digest, because I have digestive issues and the doctor recommend that I can eat more vegetables and fruits." Besides, one participant (male, 24) said that: "I believe that PBD is rich in nutrients because many advertisements claimed that vegetables has

more iron, vitamins, and other nutrients? I cannot remember clearly." Two individuals reported feeling more energized and alert after switching to PBD. They said that: " Somehow I just feel refreshed after I adopt PBD, maybe because it brings less burden to my digest system?" Additionally, some interviewees (4/29) suggested that PBD may reduce the risk of chronic diseases such as heart disease, diabetes, and some types of cancer. They said: " My family members have some chronic disease and doctors recommend PBD as a way to improve their healthy conditions." For these participants, they all had the intention to adopt PBD and had high PBI score comparing to participants who did not recognize this benefit. Among these participants, they all had the intention to adopt PBD and most of them (20/25) were categorized as high adherence to PBD.

Interviewees also mentioned about PBD's influence on the environment. A third of them (10/29) believed that it is beneficial for the environment because PBD requires fewer resources to produce, such as water, energy, and land. One participant said: " I guess it also produces less gas emission?" They thought that PBD releases less greenhouse gas emissions when compared to diets rich in animal-based products. Moreover, some participants mentioned that: " I majored in environment, I know this can lower the risk of deforestation and reduce water pollution." Additionally, a participant mentioned that PBD can reduce soil degradation, water contamination and loss of biodiversity. They all had the intention to adopt PBD, and 20 of them were categorized as high PBD adherence.

### 3.3.5 Perceived barriers

Aside from perceived benefits, perceived barriers are also related to people's willingness to make the change to adopt PBD.

A well-planned PBD can provide all the necessary nutrients and be nutritionally adequate for people of all ages, including children and pregnant or breastfeeding women. Some interviewees (8/29) mentioned that they were concerned about the intake of protein would not be enough in PBD. A participant said: "I wonder whether I can obtain enough protein from PBD." Among these participants, 75% had the intention to adopt PBD but only 25% had high PBD adherence.

Some participants (10/29) expressed that they lack time and energy to adopt and maintain PBD. This can be a significant barrier for those with busy lifestyles or limited access to fresh produce. Whether people have time and skills to prepare PBD will influence their choice. They also stated that: "I barely had time to prepare meals for myself because I am too busy." At weekends, they prefer to prepare a meal easily and quickly. They said that they did not want to spend too much time on cooking. Additionally, their meal preparation abilities are basic, therefore they prefer to avoid complicated cooking. For these participants, while most of them (9/10) had the intention to adopt PBD, their PBI score were lower than the mean score.

Besides, the high cost of PBD is also related to people's choice on PBD. During interviews, price disparity between plant-based food in markets and restaurants were discussed. A half of participants (15/29) said that plant-based food was usually cheap and affordable, but when they are processed into PBD, they

become expensive, the price even higher than a normal dietary meal. One participant said: "I do not understand why a bowl of salad can be sold as such high price." If they choose to buy PBD in restaurants, the cost was relatively high. In some popular light food restaurants, the price of PBD even higher than other types of meal. In this case, price would be the barrier for people to choose PBD. Almost all participants (n=14) had the intention to adopt PBD, while only 1/3 of them had high PBD adherence.

Many interviewees (14/29) also mentioned low availability of processed plant-based foods as a barrier. This can be a problem for individuals who follow PBD, as it can be challenging to find suitable food options that align with their dietary pattern. A participant stated that: "I rarely go to the restaurant to have meals because it is hard to find plant-based dishes." In some cases, restaurants may not even offer any plant-based meal sets at all, further limiting the options for these individuals. Most of these participants (n=12) had the intention to adopt PBD, and less than a half had high PBD adherence.

### **3.3.6 Cues to action**

Half of participants (15/29) mentioned that cues to action came from two aspects, which were viewed as stimuli that motivate them to adopt PBD. The first source included a family member or healthcare provider providing support, information, encouragement and seeing visible changes in someone they admire. As said by a participant: "My parents concerned about my health, they always



recommend some diet patterns they thought are beneficial (to me).” Another participant said that: “I did physical examination last time and my doctor said that my lab result was not good. I need to reduce the consumption of meat and have more vegies.” One participant (female, 27) mentioned:” I very like a movie star and I knew she is following PBD. She has become healthier and more beautiful since she started to adopt PBD. I wish I can have that (change) too!” Another source was that the participants wanted to make a change because of personal health benefits, such as lower risk of heart disease, diabetes, and certain types of cancer. A participant said:” I majored in Food Science, so I did some research on how diet can influence my health, and thus I knew that eating a balanced diet is important for my long-term health, this pushed me to make healthier choices even it's not always easy.” For these participants, only one of them did not have the intention to adopt PBD, the rest of them all showed the intention to adopt PBD. More than a half of them had high PBD adherence.

### **3.3.7 Modifiers**

Besides the confounders such as sex, age, lifestyle identified in the quantitative analysis, during the interview, some more modifiers including knowledge, food preference (taste), eating habit, and regional cultural influence seemed also could modify the relationship between the identified predictive factors and people ‘s intention and PBD adherence behaviors.

Most interviewees (22/29) showed limited awareness and knowledge of PBD.

This lack of awareness was reflected in the comments made by some participants who expressed that they did not know what PBD was before the interview. In some cases, some of them assumed that PBD shared the same definition with vegetarian diet or plant-based products previously, as said: "I didn't know what PBD stood for before this interview, but I assumed it was just another way of saying 'vegetarian.'" They also stated that even they knew PBD during this interview, they still did not know how to switch to PBD scientifically due to rare professional instruction.

Another important factor is food preference, specifically taste. Many participants (23/29) said that their taste preferences can greatly influence what they choose to eat, regardless of whether or not a particular food is healthy. For example, one participant (male, 27) expressed: "I prefer the taste of sugar or fast foods over healthier options like fruits and vegetables I just do not like the taste of veggie." This sentiment was echoed by other participants who also noted that taste preferences often lead them to make less healthy food choices. Moreover, participants mentioned that plant-based food is often considered less delicious and appealing than meat products, making it less desirable to some individuals. This notion was reflected in one participant's comment, "I think plant-based food cannot be compared with meat. They have totally different taste!"

Regional influence on dietary choice can be seen in a variety of ways. During interviews, residents along China's eastern and southern coast have a lighter diet and a more plant-based diet, having a variety of vegetables and eating fish and shrimp as the main source of meat. They said that: "I think the ingredients that are available in

my region definitely influence what I eat. We have a lot of fresh seafood, so I tend to eat a lot of fish and shrimp.” They also have the stereotype that people living in northern and northwestern China have mainly meat-based diets, especially red meat, and consume less vegetables. While northern and western residents explained that with the promotion of healthy eating campaign recent years, the situation has improved. They consume much more plant-based food comparing to the past, which is consistent with the quantitative analysis. People residing in the southwestern region stated that in the past, due to their preference for spicy and oily food, they consumed significantly fewer vegetables as they are not suitable for such cooking methods. They said that:” We usually had hotpot in the past, so we were used to that dietary pattern. But this has changed recently I think.” Some participants also expressed:” The food culture in my region is very focused on spicy and oily dishes. It can be hard to find healthy options sometimes, but I'm trying to make more plant-based choices.”

## 4. Discussion

This mixed method national-wide study used both online survey and interviews based on TPB and HBM theory, examined the prevalence of PBD adoption among the young adult in China and also explored the factors related to PBD adoption. The results showed that 51% of participants had relatively high PBD adoption, which aligned with previous regional research. A study conducted in 2022, Shanxi, revealed that there was 46% of targeted population who followed PBD<sup>53</sup>.

Furthermore, logistic regression analysis revealed that individuals with the intention to adopt PBD had significantly higher odds of having high PBD adherence, which is aligned with previous study<sup>54</sup>. In addition, participants who are women, having marriage and healthy lifestyle are more likely to have higher PBI score. This is also examined by other research, which found that the dietary quality of women was superior to that of men<sup>55</sup>, marriage is related to people's diet choice<sup>56</sup>. This suggests that interventions aimed at promoting healthy eating habits could focus on strategies to enhance individuals' intention to adopt PBD. The study also reinforces the importance of considering socio-demographic factors, especially population tailed in understanding and promoting healthy dietary behaviors.

This study also found that 6 factors, attitude, subjective norms, perceived control beliefs, perceived benefits, perceived barriers, cues to action, are all related to intention and PBD adherence. It is crucial to develop multi-level interventions instead of only focusing on individual behavior change. Interpersonal,

organizational, community and public policy should all make effort to promote PBD.

First, the attitudes towards adopting PBD were examined among 29 participants. The results of the study suggest that having a positive attitude towards plant-based diets can be a strong predictor of both intention and adherence to the diet. This highlights the importance of promoting positive attitudes towards PBD as a way to encourage people to adopt and maintain healthy dietary behaviors. The study also found that individuals who held negative or neutral attitudes towards PBD were less likely to express an intention to adopt the diet and were less likely to adhere to the diet. This suggests that efforts to promote PBD may need to address negative attitudes towards the diet and education institution can provide education and information to dispel misconceptions or negative beliefs. This result emphasizes the importance of understanding attitudes, intention and behavior towards dietary behaviors in order to promote healthy eating habits, which is consistent with previous study<sup>57</sup>.

In terms of subjective norms, the study found that the influence of friends and family members were associated with intention and behavior to adopt PBD. Specifically, participants who had friends and family members approve PBD were more likely to express an intention to adopt the diet themselves and were more likely to adhere to the diet. This suggests that social influence can play an important role in shaping dietary behaviors and highlights the potential for social networks to be leveraged as a means of promoting healthy eating habits, which is consistent with previous study<sup>58</sup>. At the interpersonal level, participants can be involved in

interventions that target their social networks and relationships to establish a supportive environment for people to change their dietary pattern. The study also found that the strength of subjective norms varied depending on the perceived influence of the source, with closer friends and family members having a stronger influence. Other research also provided insights into the ways in which social networks can shape individual opinions and behaviors. By understanding the factors that influence the strength of social influence, interventions aimed at promoting healthy behaviors can be designed in ways that are more likely to be effective<sup>59</sup>. The implications of these findings suggest that interventions aimed at promoting PBD may be more effective if they take into account the social networks of individuals, encouraging individuals to share their dietary goals and progress with their friends and family members may be a useful strategy for increasing the likelihood of dietary adherence.

Regarding perceived behavioral control, the study found that it was an important factor in predicting intentions and adherence to adopt PBD. Specifically, many participants said that they lack confidence in adopting the diet due to limited control over their food choices, but still expressed an intention to adopt the diet. Participants who had higher levels of confidence in their ability to change their dietary habits had a higher likelihood of expressing an intention to adopt the PBD, and were more likely to have a high adherence to the diet. The finding may suggest that individual's perception of their control over their dietary habits may have a stronger influence on their behavior than their intention to adopt PBD, which is also

examined by previous research<sup>60</sup>. This finding has important implications for interventions aimed at promoting PBD. While intentions are important, it may be more effective to focus on strategies that enhance an individual's perceived control over their food choices can directly impact their behavior, such as providing practical tools and resources that can help individuals make healthy dietary choices to adopt PBD.

The findings suggest that attitudes, subjective norms, and perceived behavioral control all played a role in determining the intention and adherence to PBD. These findings are consistent with previous research<sup>61-63</sup> on the theory of planned behavior (TPB), which posits that attitudes, subjective norms, and perceived behavioral control are predictors of behavioral intentions and behaviors.

Furthermore, the relationship between perceived benefits, barriers, cues to action and the intention to switch to PBD and adherence to PBD were also evaluated in this convergent research.

Regarding benefits, the major benefit mentioned by participants are improved health outcomes (regular bowel movement, ease digestion, increase energy level, reduce the risk of chronic disease) and environmental sustainability (consuming less resources and producing less greenhouse gas emission). Among the participants mentioned benefit of adopting PBD, all of them expressed intention and 80% had high adherence to PBD. The results indicate that participants who identified more benefits associated with adopting PBD were more likely to have high intention and adherence to the diet. This finding highlights the importance of promoting the

benefits of PBD to individuals in order to promote PBD. Previous research supports these findings. For instance, a study found that participants who perceived more benefits had greater intention to adopt the specific behavior and were more likely to adhere to it<sup>64</sup>. This may suggest that emphasizing the benefits of PBD, whether they are related to health, environmental sustainability, can be an effective strategy for promoting the adoption and maintenance of this dietary pattern.

Some perceived barriers also mentioned by the participants, including concerns about nutrition imbalance, lack of time and energy to adopt and maintain PBD, high cost of PBD, low availability of processed plant-based foods.

Primarily, some participants concerned about the nutrition imbalance, especially protein intake. Research have found that PBD can provide adequate protein for most people, as long as they consume a variety of plant-based protein sources and consume enough calories to meet their energy needs. Plant-based sources of protein include legumes, nuts, seeds, tofu, and some whole grains, among others. While some plant-based proteins may not contain all the essential amino acids in the same proportions as animal-based proteins, combining different plant-based protein sources throughout the day can help ensure adequate intake of all essential amino acids<sup>65</sup>. The implication of this is that PBD can be a healthy and nutritionally adequate dietary option for individuals of all ages, including pregnant or breastfeeding women and children, as long as they plan their meals carefully and consume a variety of plant-based protein sources. Doctors can participate and help address this problem as they can provide more professional solutions for the



population. It is important to address concerns about protein intake in PBD and educate individuals about how to obtain adequate protein from plant-based sources.

The finding also suggests that lack of time and energy to adopt and maintain PBD is another barrier to people's intention and adherence to PBD, particularly for those with busy lifestyles or limited access to fresh produce. To overcome these barriers, government and some organizations which promoting healthy eating can make contributions, such as providing simple and quick PBD recipes by organizations, promoting the use of frozen or canned fruits and vegetables by market, and offering education and training programs to enhance meal preparation skills by community or education institution. Additionally, it may be beneficial to target specific populations, such as working adults, with tailored interventions that address their unique barriers and needs. By addressing the practical challenges of adopting PBD, future interventions may be more effective in promoting healthy and sustainable dietary patterns<sup>66</sup>.

The high cost of PBD of plant-based foods is also barrier for many individuals when deciding whether to adopt PBD. Lower-income individuals may view plant-based foods as unaffordable, leading to a preference for cheaper, animal-based options. In order to increase people's adherence to PBD, there are strategies for reducing the cost of a plant-based diet, such as shopping at local farmer's markets or preparing meals at home. Understanding the influence of price on individuals' food choices can inform public health interventions aimed at promoting a more plant-based diet, making it accessible to all individuals, regardless of their economic

circumstances. Research has also shown that adopting a vegetarian diet can result in significant cost savings, as evidenced by a study in the *Journal of Hunger and Environmental Nutrition* that estimated savings of around \$750 per year<sup>67</sup>. Similarly, a study by the European Association for the Study of Obesity found that vegetarian diets were cheaper than both Mediterranean and standard US diets<sup>68</sup>. Apart from individual's effort, different stakeholders should also take action to decrease the price of plant-based meal in restaurants, making them more affordable and accessible to a wider range of customers. One approach is to source ingredients from local farmers or growers, which can reduce transportation and distribution costs. Restaurants can also buy ingredients in bulk or use less expensive cuts of produce that are still nutritious and tasty. Also, restaurants can consider offering smaller portion sizes, which can lower the cost of a meal while also reducing food waste. By implementing these strategies, restaurants can make plant-based meals more affordable and appealing to a broader audience, while also promoting sustainable dietary pattern.

Low availability of processed plant-based foods is identified as a barrier for participants to adopt PBD. The current food environment would frequently make people choose unhealthy food. Creating an environment that encourages people to choose PBD also involves several stakeholders. Firstly, increasing access to plant-based food options through initiatives such as providing plant-based meals in schools, hospitals, and workplaces, or increasing the availability of plant-based options in restaurants and grocery stores can make it easier for people to choose

plant-based foods, as stated in previous study<sup>69</sup>. Besides, providing education and information by educational institution about the benefits of a plant-based diet can help to increase awareness and understanding of why a plant-based diet is beneficial for both health and the environment<sup>70</sup>. Moreover, policy can be made to incentivize the production and consumption of plant-based foods, such as subsidies for plant-based agriculture or taxes on animal-based products, can encourage people to choose plant-based options. In addition, community can help create a supportive community through social networks, online forums, and local events can provide a sense of belonging and support for those who are transitioning to PBD<sup>71</sup>, and thus improve people's intention and adherence to PBD.

The findings also suggest that cues to action are important in motivating individuals to adopt PBD. That interventions aimed at promoting PBD should focus on providing interpersonal cues to action, such as social support from family members and healthcare providers. In addition, using social models or examples of people who have successfully adopted PBD could be a useful strategy to motivate individuals who are considering adopting PBD. Previous research has also shown that motivation from healthcare providers, family members, or friends, are important for individuals to adopt healthy behaviors. A study found that family members were important sources of support and encouragement for individuals who were trying to quit smoking<sup>72</sup>. Similarly, Anokye et al. (2013) found that receiving advice from healthcare providers was a significant predictor of physical activity among middle-aged adults<sup>73</sup>.

In terms of modifiers, this relationship can also be modified by knowledge, food preference, regional cultural influence. Lacking knowledge may contribute to negative attitudes towards PBD and decrease intention to adopt this dietary pattern. Future studies could explore the effectiveness of different approaches to educating individuals about PBD, such as through social media campaigns, workshops, or public health interventions<sup>74</sup>. In addition, the creation of a guideline for PBD is also crucial to promote this healthier eating habits as this provides detailed knowledge to the population. The term "plant-based" can be interpreted in various ways, making it difficult to provide clear guidance on what a healthy PBD should include. Developing a comprehensive guideline can help individuals understand what foods to eat and what to avoid, as well as provide recommendations on portion sizes, nutrient requirements, and potential supplements<sup>75</sup>. Such guidelines can also include recommendations on sustainable food choices, encouraging individuals to choose plant-based foods that are produced in an environmentally friendly and socially responsible manner.

Many young people interviewed also emphasized the value of flavor. They would be more likely to try PBD if this diet was delicious. Chinese consumers may be more resistant to adopting PBD due to their perception of meat as a source of pleasure or hedonism, which is strongly rooted in the culture<sup>76</sup>. Consumers who historically lacked regular access to meat, such as the study sample in China and other developing countries, may experience greater pleasure from meat consumption than those in Oceania, Europe, and North America, who have historically had higher

daily meat consumption<sup>77</sup>. The lack of desire to switch to PBD was sometimes attributed to a reluctance to give up the pleasure that comes from hedonism for meat.

The finding that regional culture influence can also greatly impact dietary choices is consistent with previous research in the field of nutrition and food studies<sup>78,79</sup>. Studies have shown that cultural factors such as traditional food habits, beliefs, and values play a critical role in shaping dietary practices. Thus, the efforts to promote healthier eating habits must take into account regional differences and tailor interventions to address cultural and social factors specific to each region. For example, interventions that promote PBD may need to emphasize different types of plant-based foods depending on regional availability and cultural acceptability. By acknowledging regional differences in dietary practices, nutrition education and promotion programs can be more effective in improving the overall dietary quality and health outcomes of populations. Future studies need to validate these findings. Relevant intervention can be developed by these modifiers for tailed population and regions.

This research has several strengths. First, this study among the first few studies examined national wide data among young Chinese adults. This research also combined quantitative and qualitative analysis. Quantitative analysis allows for the collection of large amounts of data, which can be used to identify trends and patterns in young Chinese adults' intention and behaviors towards PBD, which can help to provide a comprehensive picture of the current situation of people's acceptance of PBD. Qualitative analysis, on the other hand, allows for a more in-depth exploration of

people's attitudes, beliefs, and concerns. This can also help to identify potential barriers and facilitators to adopting PBD, which can inform the development of interventions to promote this dietary change. By combining quantitative and qualitative analysis, researchers can gain a more complete understanding of people's attitudes and behaviors toward PBD and can develop more effective strategies to promote this dietary change.

Several limitations of this research should also be noted. Firstly, the PBD score was computed based on self-reported dietary intake data, which may introduce biases in the study results. There is a possibility that participants might have inaccurately reported their dietary intake due to recall errors, social desirability bias, or a tendency to overreport healthy food consumption and underreport unhealthy food consumption. Furthermore, the dietary intake data was collected only once at the baseline, so the stability of the dietary patterns among participants is unknown. Secondly, the generalizability of the study findings is limited due to sampling concerns. Wenjuanxing was utilized to distribute online questionnaires, and most participants recruited by Wenjuanxing were from urban and generally had a high level of literacy and lead a healthy lifestyle. Therefore, the findings may not generalize to rural areas or wider population with different characteristic. Additionally, the study only included 18-35 years old young Chinese adults, which limits the generalizability of the results to other generations. Future studies are needed to validate the findings. Furthermore, while using a median score of 85 to categorize dietary behavior as high or low adherence to a PBD may not capture the full complexity of individual dietary

patterns. Some participants may have moderately high adherence to PBD, but still fall in the low adherence category based on the median score cutoff. Additionally, using a median score can obscure individual variability in dietary patterns, which may be important for understanding factors that influence dietary behavior. The current exploration among intention and behavior used small qualitative sample. Future study may use the methodology from the current study and develop a quantitative survey to validate statistical relationship between the factors and intention and behavior among the larger population.

## 5. Conclusion

In conclusion, this thesis explored the willingness of young Chinese adults to adopt PBD, using a mixed-method approach that combined quantitative and qualitative research methods. The study found that while there is a growing awareness of the benefits of PBD among young Chinese adults and high intention to adopt PBD, there are still several predictive factors that were strongly correlated with people's actual diet behavior, which may be the barriers for the promotion of PBD.

The quantitative findings showed that respondents generally had the intention towards PBD and recognized the potential health benefits. With higher intention to adopt PBD, higher adherence to PBD presented among participants. The qualitative findings further revealed that attitude, subjective norms were positively associated with participants' intention to adopt PBD and high adherence to PBD. Perceived control beliefs, perceived barriers, perceived benefits, cues to action were highly associated with their high PBD adherence. Overall, the finding suggested that these predictive factors are strongly associated with high PBD adherence, highlights the importance of taking a comprehensive approach to behavior change, beyond simply addressing intention. Understanding the factors that influence PBD adherence and developing effective strategies to address them could help promote the adoption of PBD and reduce the negative impact of animal-based food production on human health and the environment.



The study provides valuable insights into the intention and behaviors of young Chinese adults toward PBD and highlights the need for targeted interventions to address the barriers to adoption. As China continues to experience rapid economic growth and social change, promoting the adoption of PBD may have significant implications for public health and environmental sustainability.

## Appendix

Figure 2. Examples of food items constituting the 18 food groups (from the 2010 NHS SFFQ)

<i>Plant Food Groups</i>	
<i>Healthy</i>	
Whole grains	Whole grain cold breakfast cereal, other cooked breakfast cereal, cooked oatmeal or cooked oat bran (including instant), whole wheat or oatmeal or other whole grain bread, rye or pumpnickel bread, brown rice, oat bran or other bran added to food, wheat germ, regular popcorn, fat-free or light popcorn, whole grain or whole wheat crackers, corn or flour tortillas
Fruits	Raisins or grapes, prunes or dried plums, bananas, cantaloupe, fresh apples or pears, oranges, grapefruit or grapefruit juice, strawberries, blueberries, peaches or plums, apricots, avocado, mixed dried fruit
Vegetables	Tomatoes, tomato or V-8 juice, tomato sauce, salsa or picante or taco sauce, tomato soup, broccoli, cabbage or coleslaw, cauliflower, Brussels sprouts, raw carrots, cooked carrots, mixed or stir fry vegetables, dark orange (winter) squash, eggplant or zucchini or other summer squash, yams or sweet potatoes, raw spinach, cooked spinach, kale or mustard greens or chard, iceberg or head lettuce, romaine or leaf lettuce, celery, green or yellow or red peppers, onions as a garnish, cooked onions, garlic (fresh or powdered), corn
Nuts	Peanuts, walnuts, other nuts, peanut butter, flaxseed
Legumes	String beans, tofu or soy burger or soybeans or miso or other soy protein, soy milk, beans or lentils, peas or lima beans
Vegetable oils	Olive oil added to food or bread, olive oil-based salad dressing, other vegetable oil-based salad dressing, olive oil or other vegetable oil used for cooking
Tea & Coffee	Caffeinated tea (including green tea), decaffeinated tea (exclude herbal), caffeinated coffee, decaffeinated coffee
<i>Less healthy</i>	
Fruit juices	Apple cider (non-alcoholic) or juice, regular orange juice, calcium or vitamin D fortified orange juice, prune juice, other fruit juices
Refined grains	Refined grain cold breakfast cereal, white bread (including pita), English muffins or bagels or rolls, muffins or biscuits, white rice, pancakes or waffles, other crackers, pasta, pretzels

Potatoes	French fries, baked or boiled or mashed potatoes, potato or corn/tortilla chips
Sugar sweetened beverages	Carbonated beverage with caffeine and sugar, other carbonated beverages with sugar, other sugared beverages: punch or lemonade or sports drinks or sugared iced tea
Sweets and Desserts	Milk chocolate, dark chocolate, candy bars, candy without chocolate, fat-free/reduced fat cookies or brownies, other ready-made/mix/dough cookies or brownies, cookies or brownies home-baked from scratch, doughnuts, cake (homemade or ready-made), pie (homemade or ready-made), jams or jellies or preserves or syrup or honey, sweet roll or coffee cake or other pastry (regular or fat-free or reduced fat)
Animal fat	Pure butter added to food or bread, "Spreadable Butter" (butter/oil blend) added to food or bread, pure butter or lard used for cooking
Dairy	Skim milk, 1% or 2% milk, whole milk, cream (exclude fat free), frozen yogurt or sherbet or sorbet or low-fat ice cream, regular ice cream, plain yogurt, artificially sweetened yogurt, sweetened yogurt, cottage or ricotta cheese, cream cheese, other cheese, dairy coffee drink (hot/cold) e.g. Cappuccino
Egg	Omega-3 fortified eggs including yolk, regular eggs including yolk
Fish or Seafood	Canned tuna, breaded fish cakes or pieces or fish sticks, shrimp or lobster or scallops as a main dish, dark meat fish, other fish
Meat	Chicken/turkey sandwich or frozen dinner, other chicken/turkey with skin (including ground), other chicken/turkey without skin, chicken/turkey hot dogs or sausage, bacon, beef or pork hot dogs, salami or bologna or other processed meat sandwiches, other processed meats, beef/calf/pork liver, chicken/turkey liver, regular hamburger, lean or extra lean hamburger, beef/pork/lamb as a sandwich or mixed dish, beef/lamb as a main dish, pork as a main dish
Miscellaneous animal-based foods	Pizza, chowder or cream soup, low-fat or fat free mayonnaise, regular mayonnaise

## References

1. IDF Diabetes Atlas | Tenth Edition. Accessed March 9, 2023. <https://diabetesatlas.org/>
2. Noncommunicable diseases. Accessed March 3, 2023. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
3. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019 - PubMed. Accessed March 9, 2023. <https://pubmed.ncbi.nlm.nih.gov/33069326/>
4. Chronic disease to cost \$47 trillion by 2030: WEF | Reuters. Accessed March 9, 2023. <https://www.reuters.com/article/us-disease-chronic-costs-idUSTRE78H2IY20110918#>
5. Bloom DE, Chen S, Kuhn M, McGovern ME, Oxley L, Prettner K. The economic burden of chronic diseases: Estimates and projections for China, Japan, and South Korea. *J Econ Ageing*. 2020;17:100163. doi:10.1016/j.jeoa.2018.09.002
6. Imamura F, Micha R, Khatibzadeh S, et al. Dietary quality among men and women in 187 countries in 1990 and 2010: a systematic assessment. *Lancet Glob Health*. 2015;3(3):e132-e142. doi:10.1016/S2214-109X(14)70381-X
7. Li G, Zhang P, Wang J, et al. The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: a 20-year follow-up study. *Lancet Lond Engl*. 2008;371(9626):1783-1789. doi:10.1016/S0140-6736(08)60766-7
8. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study - ScienceDirect. Accessed March 9, 2023. <https://www.sciencedirect.com/science/article/abs/pii/S0140673604170189>
9. Finkelstein EA, Trogon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff Proj Hope*. 2009;28(5):w822-831. doi:10.1377/hlthaff.28.5.w822
10. Yang Q, Zhang Z, Gregg EW, Flanders WD, Merritt R, Hu FB. Added sugar intake and cardiovascular diseases mortality among US adults. *JAMA Intern Med*. 2014;174(4):516-524. doi:10.1001/jamainternmed.2013.13563
11. McMacken M, Shah S. A plant-based diet for the prevention and treatment of

type 2 diabetes. *J Geriatr Cardiol JGC*. 2017;14(5):342-354. doi:10.11909/j.issn.1671-5411.2017.05.009

12. Sheng N, Ma J, Ding W, Zhang Y. Family management affecting transition readiness and quality of life of Chinese children and young people with chronic diseases. *J Child Health Care*. 2018;22(3):470-485. doi:10.1177/1367493517753712

13. Imam MU, Ismail M. The Impact of Traditional Food and Lifestyle Behavior on Epigenetic Burden of Chronic Disease. *Glob Chall*. 2017;1(8):1700043. doi:10.1002/gch2.201700043

14. Vandevijvere S, Monteiro C, Krebs-Smith SM, et al. Monitoring and benchmarking population diet quality globally: a step-wise approach. *Obes Rev Off J Int Assoc Study Obes*. 2013;14 Suppl 1:135-149. doi:10.1111/obr.12082

15. Hawkes C. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. *Glob Health*. 2006;2:4. doi:10.1186/1744-8603-2-4

16. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 - PubMed. Accessed March 9, 2023. <https://pubmed.ncbi.nlm.nih.gov/30954305/>

17. Mikkilä V, Räsänen L, Raitakari OT, Pietinen P, Viikari J. Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study. *Eur J Clin Nutr*. 2004;58(7):1038-1045. doi:10.1038/sj.ejcn.1601929

18. Consistent dietary patterns identified from childhood to adulthood: The Cardiovascular Risk in Young Finns Study | British Journal of Nutrition | Cambridge Core. Accessed March 3, 2023. <https://www-cambridge-org.proxy.lib.duke.edu/core/journals/british-journal-of-nutrition/article/consistent-dietary-patterns-identified-from-childhood-to-adulthood-the-cardiovascular-risk-in-young-finns-study/E6100BF40DD6B25D8EA7084093058816>

19. Satija A, Bhupathiraju SN, Rimm EB, et al. Plant-Based Dietary Patterns and Incidence of Type 2 Diabetes in US Men and Women: Results from Three Prospective Cohort Studies. *PLoS Med*. 2016;13(6):e1002039-e1002039. doi:10.1371/journal.pmed.1002039

20. Jasinska AJ, Yasuda M, Burant CF, et al. Impulsivity and inhibitory control deficits are associated with unhealthy eating in young adults. *Appetite*. 2012;59(3):738-747. doi:10.1016/j.appet.2012.08.001

21. Zhang R, Wang Z, Fei Y, et al. The Difference in Nutrient Intakes between Chinese and Mediterranean, Japanese and American Diets. *Nutrients*. 2015;7(6):4661-4688. doi:10.3390/nu7064661
22. Yang YX, Wang XL, Leong PM, et al. New Chinese dietary guidelines: Healthy eating patterns and food-based dietary recommendations. *Asia Pac J Clin Nutr*. 27(4):908-913. doi:10.3316/ielapa.762435308484087
23. Frontiers | Consumption of aquatic products and meats in Chinese residents: A nationwide survey. Accessed October 30, 2022. <https://www.frontiersin.org/articles/10.3389/fnut.2022.927417/full>
24. Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality | Cardiology | JAMA Internal Medicine | JAMA Network. Accessed October 30, 2022. <https://jamanetwork-com.proxy.lib.duke.edu/journals/jamainternalmedicine/fullarticle/2759737>
25. Food groups and risk of all-cause mortality: a systematic review and meta-analysis of prospective studies | The American Journal of Clinical Nutrition | Oxford Academic. Accessed March 3, 2023. <https://academic-oup-com.proxy.lib.duke.edu/ajcn/article/105/6/1462/4569801>
26. Satija A, Hu FB. Plant-based diets and cardiovascular health. *Trends Cardiovasc Med*. 2018;28(7):437-441. doi:10.1016/j.tcm.2018.02.004
27. Li D. Effect of the vegetarian diet on non-communicable diseases. *J Sci Food Agric*. 2014;94(2):169-173. doi:10.1002/jsfa.6362
28. De Venecia T, Lu M, Figueredo VM. Hypertension in young adults. *Postgrad Med*. 2016;128(2):201-207. doi:10.1080/00325481.2016.1147927
29. Zhu A, Chen H, Shen J, et al. Interaction between plant-based dietary pattern and air pollution on cognitive function: a prospective cohort analysis of Chinese older adults. *Lancet Reg Health – West Pac*. 2022;20. doi:10.1016/j.lanwpc.2021.100372
30. Lee KW, Loh HC, Ching SM, Devaraj NK, Hoo FK. Effects of Vegetarian Diets on Blood Pressure Lowering: A Systematic Review with Meta-Analysis and Trial Sequential Analysis. *Nutrients*. 2020;12(6):1604. doi:10.3390/nu12061604
31. Chen Z, Drouin-Chartier JP, Li Y, et al. Changes in Plant-Based Diet Indices and Subsequent Risk of Type 2 Diabetes in Women and Men: Three U.S. Prospective Cohorts. *Diabetes Care*. 2021;44(3):663-671. doi:10.2337/dc20-1636

32. Li Y, Wang DD, Satija A, et al. Plant-Based Diet Index and Metabolic Risk in Men: Exploring the Role of the Gut Microbiome. *J Nutr.* 2021;151(9):2780-2789. doi:10.1093/jn/nxab175
33. Chen Z, Zuurmond MG, van der Schaft N, et al. Plant versus animal based diets and insulin resistance, prediabetes and type 2 diabetes: the Rotterdam Study. *Eur J Epidemiol.* 2018;33(9):883-893. doi:10.1007/s10654-018-0414-8
34. Loeb S, Fu BC, Bauer SR, et al. Association of Plant-Based Diet Index with Prostate Cancer Risk. *Am J Clin Nutr.* Published online November 13, 2021:nqab365. doi:10.1093/ajcn/nqab365
35. Van Loo EJ, Hoefkens C, Verbeke W. Healthy, sustainable and plant-based eating: Perceived (mis)match and involvement-based consumer segments as targets for future policy. *Food Policy.* 2017;69:46-57. doi:10.1016/j.foodpol.2017.03.001
36. Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet.* 2019;393(10170):447-492. doi:10.1016/S0140-6736(18)31788-4
37. Macassa G. Can sustainable health behaviour contribute to ensure healthy lives and wellbeing for all at all ages (SDG 3)? : A viewpoint. *J Public Health Res.* 2021;10(3). Accessed November 20, 2021. <http://urn.kb.se/resolve?urn=urn:nbn:se:hig:diva-35681>
38. Publication preview page | FAO | Food and Agriculture Organization of the United Nations. FAODocuments. doi:10.4060/cc3657en
39. McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-Analysis of the Reasoned Action Approach (RAA) to Understanding Health Behaviors. *Ann Behav Med.* 2016;50(4):592-612. doi:10.1007/s12160-016-9798-4
40. Corrin T, Papadopoulos A. Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs. *Appetite.* 2017;109:40-47. doi:10.1016/j.appet.2016.11.018
41. Yazdanpanah M, Forouzani M, Hojjati M. Willingness of Iranian young adults to eat organic foods: Application of the Health Belief Model. *Food Qual Prefer.* 2015;41:75-83. doi:10.1016/j.foodqual.2014.11.012
42. Rosenstock IM. Health Belief Model. In: *Encyclopedia of Psychology, Vol. 4.* American Psychological Association; 2000:78-80. doi:10.1037/10519-035
43. Urbanovich T, Bevan JL. Promoting Environmental Behaviors: Applying the Health Belief Model to Diet Change. *Environ Commun.* 2020;14(5):657-671.

doi:10.1080/17524032.2019.1702569

44. Fila SA, Smith C. Applying the Theory of Planned Behavior to healthy eating behaviors in urban Native American youth. *Int J Behav Nutr Phys Act.* 2006;3:11. doi:10.1186/1479-5868-3-11
45. Wyker BA, Davison KK. Behavioral Change Theories Can Inform the Prediction of Young Adults' Adoption of a Plant-based Diet. *J Nutr Educ Behav.* 2010;42(3):168-177. doi:10.1016/j.jneb.2009.03.124
46. Ates H, Demir Özdenk G, Çaliskan C. Determinants of Science Teachers' Healthy Eating Behaviors: Combining Health Belief Model and Theory of Planned Behavior. *J Balt Sci Educ.* 2021;20(4):573-589.
47. Predicting and Changing Behavior | The Reasoned Action Approach | Mart. Accessed October 26, 2022. <https://www.taylorfrancis.com/books/mono/10.4324/9780203838020/predicting-changing-behavior-martin-fishbein-icek-ajzen>
48. Rosenfeld DL, Burrow AL. The unified model of vegetarian identity: A conceptual framework for understanding plant-based food choices. *Appetite.* 2017;112:78-95. doi:10.1016/j.appet.2017.01.017
49. Boston 677 Huntington Avenue, Ma 02115 +1495-1000. General Documentation. Nutrition Questionnaire Service Center. Published January 28, 2022. Accessed March 10, 2023. <https://www.hsph.harvard.edu/nutrition-questionnaire-service-center/general-documentation/>
50. Satija A, Malik V, Rimm EB, Sacks F, Willett W, Hu FB. Changes in intake of plant-based diets and weight change: results from 3 prospective cohort studies. *Am J Clin Nutr.* 2019;110(3):574-582. doi:10.1093/ajcn/nqz049
51. Chen M, Creger T, Howard V, Judd SE, Harrington KF, Fontaine KR. Geospatial analysis of Mediterranean diet adherence in the United States. *Public Health Nutr.* 2021;24(10):2920-2928. doi:10.1017/S1368980020001135
52. Hagger MS. The Reasoned Action Approach and the Theories of Reasoned Action and Planned Behavior. doi:10.1093/obo/9780199828340-0240
53. Zhang Y, Meng Y, Wang J. Higher Adherence to Plant-Based Diet Lowers Type 2 Diabetes Risk among High and Non-High Cardiovascular Risk Populations: A Cross-Sectional Study in Shanxi, China. *Nutrients.* 2023;15(3):786. doi:10.3390/nu15030786
54. Sheeran P, Maki A, Montanaro E, et al. The impact of changing attitudes, norms,



- and self-efficacy on health-related intentions and behavior: A meta-analysis. *Health Psychol.* 2016;35:1178-1188. doi:10.1037/hea0000387
55. Hiza HAB, Casavale KO, Guenther PM, Davis CA. Diet Quality of Americans Differs by Age, Sex, Race/Ethnicity, Income, and Education Level. *J Acad Nutr Diet.* 2013;113(2):297-306. doi:10.1016/j.jand.2012.08.011
56. Werneck AO, Winpenny EM, Foubister C, et al. Cohabitation and marriage during the transition between adolescence and emerging adulthood: A systematic review of changes in weight-related outcomes, diet and physical activity. *Prev Med Rep.* 2020;20:101261. doi:10.1016/j.pmedr.2020.101261
57. KIM MS, HUNTER JE. Relationships Among Attitudes, Behavioral Intentions, and Behavior: A Meta-Analysis of Past Research, Part 2. *Commun Res.* 1993;20(3):331-364. doi:10.1177/009365093020003001
58. Pelletier JE, Graham DJ, Laska MN. Social norms and dietary behaviors among young adults. *Am J Health Behav.* 2014;38(1):144-152. doi:10.5993/AJHB.38.1.15
59. Moussaïd M, Kämmer JE, Analytis PP, Neth H. Social Influence and the Collective Dynamics of Opinion Formation. *PLOS ONE.* 2013;8(11):e78433. doi:10.1371/journal.pone.0078433
60. Schifter DE, Ajzen I. Intention, perceived control, and weight loss: An application of the theory of planned behavior. *J Pers Soc Psychol.* 1985;49:843-851. doi:10.1037/0022-3514.49.3.843
61. Vermeir I, Verbeke W. Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values. *Ecol Econ.* 2008;64(3):542-553. doi:10.1016/j.ecolecon.2007.03.007
62. Lentz G, Connelly S, Miroso M, Jowett T. Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite.* 2018;127:230-241. doi:10.1016/j.appet.2018.04.015
63. Wang O, Scrimgeour F. Willingness to adopt a more plant-based diet in China and New Zealand: Applying the theories of planned behaviour, meat attachment and food choice motives. *Food Qual Prefer.* 2021;93:104294. doi:10.1016/j.foodqual.2021.104294
64. Parsons JT, Siegel AW, Cousins JH. Late adolescent risk-taking: effects of perceived benefits and perceived risks on behavioral intentions and behavioral change. *J Adolesc.* 1997;20(4):381-392. doi:10.1006/jado.1997.0094

65. Ewy MW, Patel A, Abdelmagid MG, et al. Plant-Based Diet: Is It as Good as an Animal-Based Diet When It Comes to Protein? *Curr Nutr Rep.* 2022;11(2):337-346. doi:10.1007/s13668-022-00401-8
66. Graça J, Godinho CA, Truninger M. Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions. *Trends Food Sci Technol.* 2019;91:380-390. doi:10.1016/j.tifs.2019.07.046
67. Flynn MM, Schiff AR. Economical Healthy Diets (2012): Including Lean Animal Protein Costs More Than Using Extra Virgin Olive Oil. *J Hunger Environ Nutr.* 2015;10(4):467-482. doi:10.1080/19320248.2015.1045675
68. A vegetarian diet is not only good for you -- | EurekAlert! Accessed February 27, 2023. <https://www.eurekalert.org/news-releases/807902>
69. Brug J. Determinants of healthy eating: motivation, abilities and environmental opportunities. *Fam Pract.* 2008;25(suppl\_1):i50-i55. doi:10.1093/fampra/cmn063
70. Food Environment Interventions to Improve the Dietary Behavior of Young Adults in Tertiary Education Settings: A Systematic Literature Review - ScienceDirect. Accessed March 6, 2023. <https://www.sciencedirect.com/science/article/pii/S2212267215011144>
71. Aschemann-Witzel J, Gantriis RF, Fraga P, Perez-Cueto FJA. Plant-based food and protein trend from a business perspective: markets, consumers, and the challenges and opportunities in the future. *Crit Rev Food Sci Nutr.* 2021;61(18):3119-3128. doi:10.1080/10408398.2020.1793730
72. Lee YO, Hebert CJ, Nonnemaker JM, Kim AE. Multiple tobacco product use among adults in the United States: cigarettes, cigars, electronic cigarettes, hookah, smokeless tobacco, and snus. *Prev Med.* 2014;62:14-19. doi:10.1016/j.ypmed.2014.01.014
73. Anokye NK, Trueman P, Green C, Pavey TG, Taylor RS. Physical activity and health related quality of life. *BMC Public Health.* 2012;12(1):624. doi:10.1186/1471-2458-12-624
74. Han A, Sun T, Ming J, Chai L, Liao X. Are the Chinese Moving toward a Healthy Diet? Evidence from Macro Data from 1961 to 2017. *Int J Environ Res Public Health.* 2020;17(15):5294. doi:10.3390/ijerph17155294
75. Hever J. Plant-Based Diets: A Physician's Guide. *Perm J.* 2016;20(3):15-082. doi:10.7812/TPP/15-082

76. Macdiarmid JI, Douglas F, Campbell J. Eating like there's no tomorrow: Public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet. *Appetite*. 2016;96:487-493. doi:10.1016/j.appet.2015.10.011
77. OECD. *OECD-FAO Agricultural Outlook 2019-2028*. Organisation for Economic Co-operation and Development; 2019. Accessed February 23, 2023. [https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2019-2028\\_agr\\_outlook-2019-en](https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2019-2028_agr_outlook-2019-en)
78. Pestoni G, Krieger JP, Sych JM, Faeh D, Rohrmann S. Cultural Differences in Diet and Determinants of Diet Quality in Switzerland: Results from the National Nutrition Survey menuCH. *Nutrients*. 2019;11(1):126. doi:10.3390/nu11010126
79. Ma G. Food, eating behavior, and culture in Chinese society. *J Ethn Foods*. 2015;2(4):195-199. doi:10.1016/j.jef.2015.11.004
80. Chung J, Stoel L, Xu Y, Ren J. Predicting Chinese consumers' purchase intentions for imported soy-based dietary supplements. *Br Food J*. 2012;114(1):143-161. doi:10.1108/00070701211197419