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CROSS-PLATFORM  
FOOD SHOPPING  
AND HOUSEHOLD  
FOOD ACCESS IN  
NANJING, CHINA

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## Abstract

Modern urban food systems have evolved into international, multi-scalar and complex networks. The historical evolution of the food system in Nanjing, China, exemplifies this complexity. Nanjing's food system has undergone successive waves of modernization, bringing changes in consumer food sourcing behaviour along with it. Using household survey data, this investigation assesses the cross-platform food sourcing behaviour of households in Nanjing to untangle some of the complex relationships linking food retailers to consumers in the city. The findings indicate that the surveyed households largely prefer purchasing fresh food from wet markets over prepared food from fast food retailers, restaurants and online vendors. That said, households that used any of these three food sources displayed a greater diversity in their food sourcing than the majority of households that accessed wet markets and supermarkets. These findings indicate a network of food access preferences among Nanjing households.

## Keywords

household food security, food access, shopping, urbanization

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## Introduction

Since the late 1970s, China has undergone four decades of economic growth that have elevated the country to the position of the world's second largest economy. Economic development has been accompanied by rapid urbanization and pivotal changes in the food system (Garnett and Wilkes 2014). China's agricultural sector has dramatically transformed from a subsistence to a market-based system which is heavily dependent upon industrial inputs such as synthetic fertilizer and chemical pesticides and herbicides (Luan et al 2013, Zolin et al 2017). Although national food security is still the top priority for the state, the country has been increasingly reliant upon food imports (Fukase and Martin 2016). A growing demand for animal protein and processed food has accompanied the increase in disposable income of the country's citizens (Veeck and Burns 2005). The modernizing food supply system has seen new players emerging in cities – including supermarkets, online food markets, and fast food chains – which are reshaping people's daily food sourcing behaviour (Zhang and Pan 2013). Urban residents enjoy more choice of food sources, distinguished from one another by the foods they carry, their organizational structure, and their business models. As a result, “cross-platform shopping” is replacing “one-stop shopping”, even as traditional food markets continue to play a vital role in household daily food access (Maruyama et al 2016, Si et al 2018).

As the world is rapidly becoming urbanized, cities are playing an increasingly critical role in the global food security agenda and in ensuring the sustainable future of the food system (Crush 2016, Crush and Frayne 2011, Pothukuchi and Kaufman 1999). In the global context, consumer studies have examined the phenomenon of cross-platform shopping behaviour (or multi-channel or multi-format shopping) in different socioeconomic contexts (Jayasankaraprasad 2014, Jayasankaraprasad and Kathyayani 2014, Koistinen and Järvinen 2009, McGoldrick and Collins 2007). Consumers source food from multiple venues to maximize the value of their scarce resources, whether in the form of money,

time, or effort (Jayasankaraprasad 2014). Berman and Evans (2010) identify two forms of cross-platform shopping behaviour: first, consumers shop for a category of products at more than one retail format; and second, consumers tend to visit multiple retailers on one trip. Researchers have argued that various factors are triggering and shaping cross-platform shopping behaviour, including the product assortment of retailers, convenience of shopping at a particular food store, impulse buying, and perceived time pressure (Abidin et al 2016, Skallerud et al 2009).

Studies of cross-platform shopping in both industrialized and emerging economies have mainly focused on the motives of shoppers and the factors affecting consumer choice of food outlets (Hino 2010 2014, Jayasankaraprasad and Kathyayani 2014, Korneliussen and Olsen 2009, Skallerud et al 2009, Slamet and Nakayasu 2016, Veeck and Burns 2005). Only a few studies have focused on patterns of consumer cross-platform food sourcing behaviour at the municipal level. Vankim et al (2015), for example, have examined the food shopping patterns of students from the perspective of nutrition intervention. Gustafson (2017) interrogates how the neighbourhood food environment and the Supplemental Nutrition Assistance Programme affect food shopping and purchasing choices. Yoo et al (2006) examine consumers' food purchasing patterns in terms of frequency in the Houston area of the US. Food sources other than conventional food retailing formats (i.e. supermarkets, hypermarkets, specialty stores, convenience stores and traditional stores), such as online food markets and mobile street vendors, are rarely discussed in these studies.

Studies of cross-platform shopping in China focus on the modernization of food retailing, including the diffusion of supermarkets and the factors preventing supermarkets from displacing traditional food outlets (Maruyama and Wu 2014, Maruyama et al 2016, Zhang and Pan 2013). This is related to the fact that regulators in China have attempted to replace traditional food outlets with modern ones, as exemplified in the program to transform wet markets into supermarkets since 2002 (Maruyama et al 2016). These studies aim to explain the reasons

for current cross-platform shopping behaviour and thus service the interests of food retailing in its efforts to become more competitive and attractive to consumers.

This paper investigates the complex food sourcing behaviours of households in the city of Nanjing in China. It addresses the question of whether there are any consistent patterns in household access to different food sources and, if so, what form these take. While there are various ways to depict consumer food sourcing behaviour (for example, places, items, time and frequency, and methods of purchase), to capture the full spectrum of food sourcing behaviour, it is necessary to examine not only conventional food retailing formats such as supermarkets, wet markets, small food stores and street food vendors, but also online food markets, fast food chains and restaurants. Understanding the patterns of daily food sourcing behaviour provides a lens to examine the operation of an urban food system, and thus valuable insights for urban food planning and governance.

Given the complexity of urban food systems, and their relatively hidden nature, the Nanjing food system needs to be understood at both a macro-system and a micro-household scale. Households in Nanjing engage a diverse number of food sources but there is a pattern in the way that households access these food sources (potentially due to preference, convenience and income). The paper first provides an overview of the household survey on which the analysis is based and identifies the major food sources in Nanjing that emerged in the survey results. It then explains the methods used to investigate the patterns in the food sourcing behaviour of the sampled households. Finally, it presents the results of the survey, analyzes the factors contributing to the identified patterns, and discusses the implications for future research.

## Methodology

In July 2015, the Hungry Cities Partnership collaborated with Nanjing University to administer

an urban household food security survey to 1,210 households residing within Nanjing. The survey sample was proportionately allocated across all districts in the city. The multi-stage sampling strategy relied on randomly selecting sub-districts and communities within each district, and proportionately allocating the survey sample size across these selected areas. Within each community, survey enumerators used a computationally assisted random walk pattern to select households for interview. The survey instrument collected information on household demographics, food sourcing, and food safety attitudes among the households.

Using the data collected from the household surveys, this paper identifies variables from the survey measuring household access to different food sources in the previous year. These variables include the frequency of household access to supermarkets, online food retailers, small shops, fast food enterprises, restaurants, wet markets and street sellers (Table 1). To aid in interpretation, the order of these variables has been reformatted so that higher numeric codes indicate increasing frequency of access.

These variables were binned into binary indicators for some analyses to indicate two values: Not Accessed (1) or Accessed (2-6) in the previous year. Using these binary variables, an additional variable was computed that summed the number of food sources accessed by households in the previous year.

The analysis used frequency distributions to demonstrate the frequency with which the identified food sources were accessed in the last year by the sampled households. To identify patterns in access to the food sources, both graphical and statistical methods were used. First, a web graph was constructed to determine the extent of co-occurrence in household access to different food sources. This graph was then confirmed by two forms of correlation analysis. The frequency of household access to the different food sources was correlated using a Spearman's Rho correlation coefficient. The binary variables indicating whether or not households accessed these food sources were compared using odds ratios and Pearson chi-square analysis (to determine whether access to one food source

TABLE 1: Variables Included in Study

Variables	Numeric Codes and Text Labels					
	1	2	3	4	5	6
Supermarket	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Online	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Small shop	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Fast food	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Restaurant	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Wet market	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week
Street seller	Never in the last year	> Once per year	> Once per six months	> Once per month	> Once per week	> Five days per week

significantly changed the odds of household access to another food source). Finally, the average number of food sources accessed by households in the previous year were compared based on household access to each of the food sources.

## Patterns of Food Sourcing Behaviour

The frequency distribution in Table 2 provides important insights into the food sources of households in Nanjing. Supermarkets and wet markets are the most commonly and frequently accessed food sources. Among the surveyed households, 56% accessed supermarkets at least once per week but less than five days per week, while 70% accessed wet markets at least five days per week. Online retailers, fast food outlets, and street sellers were the least commonly accessed food sources. In the year before the survey, 17% of the surveyed households accessed online food retailers, 16% accessed fast food retailers, and 24% accessed street sellers. Of the households that did access these food sources, access tended to be on a monthly basis (in the case of online food retailers, fast food outlets and restaurants), while street sellers tended to be accessed at least once per week.

Among the sampled households that accessed

different food sources, there were differences in the diversity of sources accessed. For example, households that accessed fast food outlets demonstrated the greatest diversity in food sourcing (accessing an average of 5.16 food sources among the seven food sources identified). On the other hand, those households that accessed supermarkets and wet markets had the lowest average food source diversity (averaging 3.39 and 3.23 respectively of the seven food sources).

The correlations relating frequency of household access to different food sources highlight various findings (Table 4). The strongest correlations in the frequency of food source access are between the frequency of household access to fast food outlets and restaurants ( $\rho = 0.399$ ) and the frequency of household access to online food retailers and restaurants ( $\rho = 0.304$ ). In other words, increasing frequency in access to one of these sources is associated with increasing frequency in access to the other source. There was also a very weak (but statistically significant) correlation between the frequency of household access to street sellers and online food retailers. The analysis also did not find any statistically significant correlations between the frequency of household access to wet markets and online food retailers, small shops or restaurants. Finally, there are no statistically significant correlations between the frequency of household access to supermarkets and small shops or street sellers.

**TABLE 2: Distribution of the Frequency of Household Access to Food Sources**

	Never in the last year (%)	> Once per year (%)	> Once per six months (%)	> Once per month (%)	> Once per week (%)	> Five days per week (%)
Supermarket	11.8	0.1	1.3	15.7	56.4	14.7
Online	82.5	0.7	1.3	10.2	4.6	0.8
Small shop	69.9	0.3	1.1	5.9	17.7	5.1
Fast food	84.4	0.6	1.2	6.7	5.2	2.0
Restaurant	56.0	2.7	9.2	20.1	10.6	1.4
Wet market	7.0	0.1	0.2	2.2	20.6	70.0
Street seller	76.2	0.3	0.5	5.3	14.0	3.8

**TABLE 3: Average Number of Food Sources Accessed by Households by Type of Food Source Accessed**

Food source accessed	Mean no. of food sources accessed	Standard deviation	N
Wet market	3.23	1.44	1,121
Supermarket	3.39	1.38	1,053
Restaurant	4.28	1.26	524
Small shop	4.51	1.32	360
Street seller	4.53	1.44	285
Online	4.80	1.36	210
Fast food	5.16	1.31	187

**TABLE 4: Spearman’s Rho Correlation Matrix Relating the Frequency of Household Food Source Access**

		Wet market	Supermarket	Online	Small shop	Fast food	Restaurant	Street seller
Wet market	Rho	1	0.101**	-0.035	-0.023	-.098**	-0.010	.092**
	Sig.	.	<0.001	0.233	0.42	0.001	0.735	0.001
	N	1205	1194	1197	1197	1199	1189	1196
Supermarket	Rho	0.101**	1	0.146**	0.030	.099**	0.181**	0.004
	Sig.	<0.001	.	<0.001	0.307	0.001	<0.001	0.894
	N	1194	1194	1186	1186	1188	1179	1185
Online	Rho	-0.035	0.146**	1	0.154**	0.304**	0.319**	0.092**
	Sig.	0.233	<0.001	.	<0.001	<0.001	<0.001	0.002
	N	1197	1186	1198	1191	1193	1184	1190
Small shop	Rho	-0.023	0.030	0.154**	1	0.241**	0.267**	0.270**
	Sig.	0.42	0.307	<0.001	.	<0.001	<0.001	<0.001
	N	1197	1186	1191	1198	1193	1186	1191
Fast food	Rho	-0.098**	0.099**	0.304**	0.241**	1	0.399**	0.187**
	Sig.	0.001	0.001	<0.001	<0.001	.	<0.001	<0.001
	N	1199	1188	1193	1193	1200	1185	1191
Restaurant	Rho	-0.010	0.181**	0.319**	0.267**	0.399**	1	0.113**
	Sig.	0.735	<0.001	<0.001	<0.001	<0.001	.	<0.001
	N	1189	1179	1184	1186	1185	1190	1181
Street seller	Rho	0.092**	0.004	0.092**	0.270**	0.187**	0.113**	1
	Sig.	0.001	0.894	0.002	<0.001	<0.001	<0.001	.
	N	1196	1185	1190	1191	1191	1181	1197

Note: \* p<0.05, \*\* p<0.01

Despite the widespread use of both supermarkets and wet markets, there does not appear to be a strong relationship in the frequency with which these food sources were accessed ( $\rho = 0.101$ ). The possible reason for the relatively low  $\rho$  is that there are far fewer supermarkets than wet markets in Nanjing. According to Zhong et al (2018), there were 68 supermarkets selling fresh produce and 351 wet markets in the city in 2015. However, the low  $\rho$  suggests a complementary rather than a substitute relationship between access to wet markets and supermarkets. One study indicated that the quality of some fresh produce in supermarkets is better than in wet markets, although prices in wet markets are generally lower than in supermarkets (Wei 2016). Studies found that processed food such as snacks and dairy products are more popular foods from supermarkets than wet markets. Consumers tend to source fresh produce and meat from wet markets, and staple grains, dairy products and processed food from supermarkets (Si and Zhong 2018). In addition, some high-end products (such as salmon, high-end fruits and beef) are sold in supermarkets and not in wet markets.

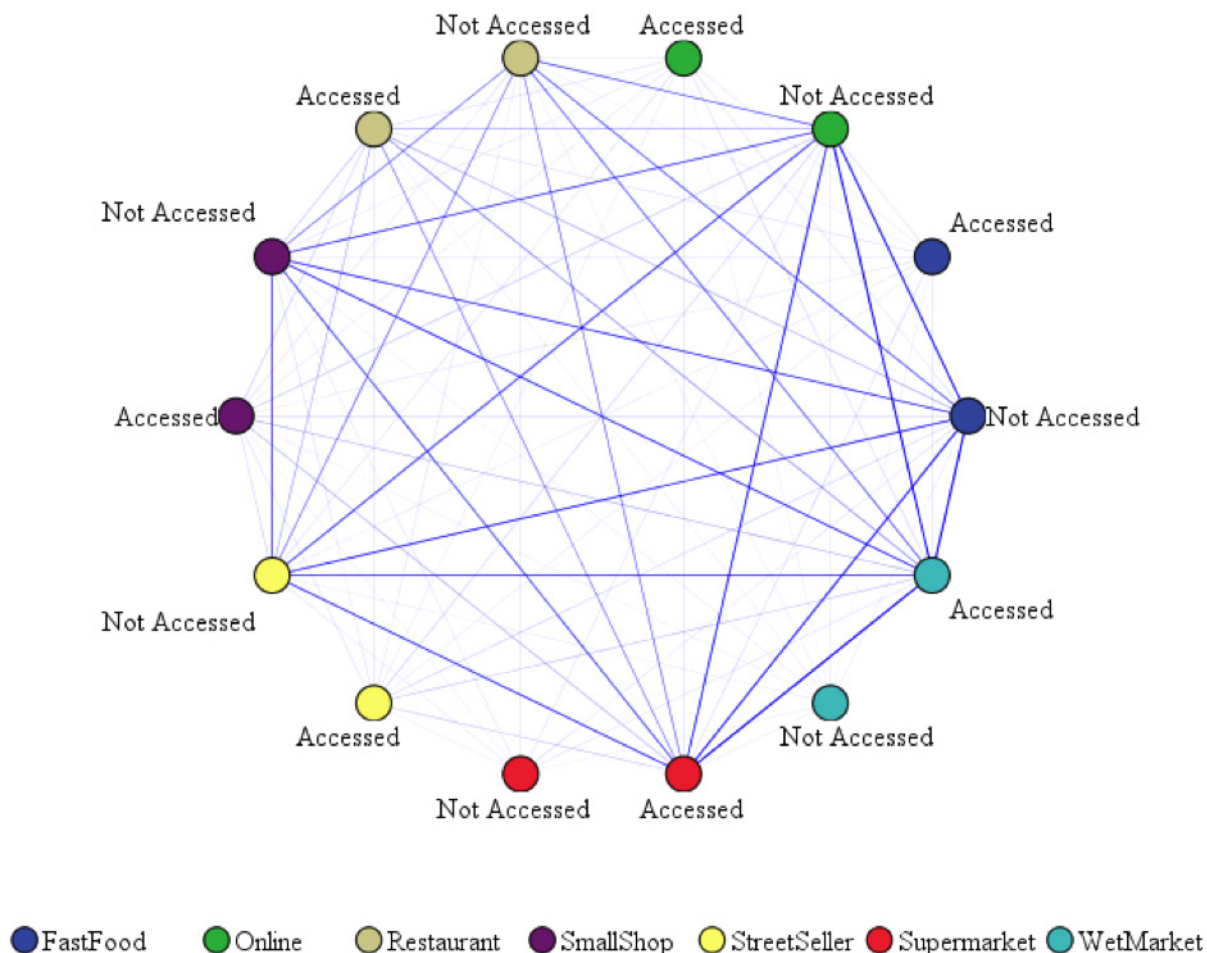
These all suggest a complementary rather than a competitive relationship between supermarkets and wet markets. This complementary relationship could be an important reason for the survival of wet markets despite the rapid expansion of supermarkets, in addition to the wet markets' price advantage (Bougoure and Lee 2009), provision of space for social interactions (Mele et al 2015), and special offers for specific customers (Chen et al 2015).

Figure 1 and Table 5 reveal various patterns in household access to different food sources. The web graph of household food sources indicates any connections between household access to food sources in the last year. These connections (represented by an edge in the graph) also indicate the number of households that can be categorized according to their access (or lack of access) to the different food

sources included in the graph. The number of households that accessed any two food sources is represented by the weight of the line, where thicker lines represent a greater number of households. The web graph demonstrates that most households (83%) accessed both supermarkets and wet markets in the previous year. Most of the households that accessed wet markets did not access fast food retailers (79% of the sample), online food retailers (77%) or street sellers (70%). The same was true of supermarkets. Most of the households that accessed supermarkets in the previous year did not access fast food retailers (73% of the sample), online food retailers (71%) or street sellers (67%). These findings suggest that most patrons of supermarkets and wet markets do not tend to access fast food retailers, online food retailers or street sellers.

Comparing the findings derived from the web graph in Figure 1, there are changes in the odds of household access to different food sources (Table 6). The households that accessed fast food outlets had a 10-fold increase in the odds of also accessing restaurants (when compared with households that did not access fast food). Similarly, households that accessed online food retailers had a five-fold increase in the odds of accessing fast food outlets and a four-fold increase in the odds of accessing restaurants. These odds ratios were accompanied by statistically significant Pearson chi-square values at an alpha of 0.05. As expected, the analysis found insignificant changes in the odds of accessing online food retailers, small shops and restaurants based on household access to wet markets. The analysis also found a statistically insignificant change in the odds of access to street sellers based on household access to supermarkets. Interestingly, households that accessed fast food outlets in the previous year had increased odds of accessing supermarkets, but decreased odds of accessing wet markets, when compared to households that did not access fast food outlets.

**FIGURE 1: Web Graph of Absolute Number of Households Categorized According to the Co-Occurrence of Access to Food Sources**



**TABLE 5: Frequency Distribution of Qualitative Access to Food Sources**

		Supermarket		Online		Small shop		Fast food		Restaurant		Wet market		Street seller	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Supermarket	No	11.8%	0.0%	11.2%	0.7%	9.9%	2.0%	11.2%	0.7%	10.3%	1.6%	1.9%	9.9%	9.6%	2.2%
	Yes	0.0%	88.2%	71.1%	17.0%	59.9%	28.2%	73.1%	15.0%	45.5%	42.6%	5.0%	83.2%	66.7%	21.5%
Online	No	11.2%	71.1%	82.5%	0.0%	60.7%	21.9%	73.9%	8.5%	51.3%	31.1%	5.3%	77.2%	64.6%	17.9%
	Yes	0.7%	17.0%	0.0%	17.5%	9.3%	8.1%	10.6%	6.9%	4.8%	12.8%	1.8%	15.8%	11.8%	5.7%
Small shop	No	9.9%	59.9%	60.7%	9.3%	69.9%	0.0%	63.0%	7.0%	45.9%	24.2%	4.5%	65.5%	58.5%	11.4%
	Yes	2.0%	28.2%	21.9%	8.1%	0.0%	30.1%	21.5%	8.5%	10.1%	19.8%	2.4%	27.6%	17.6%	12.4%
Fast food	No	11.2%	73.1%	73.9%	10.6%	63.0%	21.5%	84.4%	0.0%	54.0%	30.5%	5.0%	79.4%	67.4%	17.1%
	Yes	0.7%	15.0%	8.5%	6.9%	7.0%	8.5%	0.0%	15.6%	2.2%	13.3%	2.0%	13.6%	8.8%	6.6%
Restaurant	No	10.3%	45.5%	51.3%	4.8%	45.9%	10.1%	54.0%	2.2%	56.0%	0.0%	4.0%	51.9%	46.1%	9.9%
	Yes	1.6%	42.6%	31.1%	12.8%	24.2%	19.8%	30.5%	13.3%	0.0%	44.0%	3.0%	41.0%	30.7%	13.3%
Wet market	No	1.9%	5.0%	5.3%	1.8%	4.5%	2.4%	5.0%	2.0%	4.0%	3.0%	7.0%	0.0%	6.0%	1.0%
	Yes	9.9%	83.2%	77.2%	15.8%	65.5%	27.6%	79.4%	13.6%	51.9%	41.0%	0.0%	93.0%	70.2%	22.7%
Street seller	No	9.6%	66.7%	64.6%	11.8%	58.5%	17.6%	67.4%	8.8%	46.1%	30.7%	6.0%	70.2%	76.2%	0.0%
	Yes	2.2%	21.5%	17.9%	5.7%	11.4%	12.4%	17.1%	6.6%	9.9%	13.3%	1.0%	22.7%	0.0%	23.8%



TABLE 6: Odds Ratios Comparing Access to Each Food Source Accessed

	Supermarket	Online	Small shop	Fast food	Restaurant	Wet market	Street seller
Supermarket		3.984**	2.290**	3.405**	6.014**	3.226**	1.415
Online	3.984**		2.396**	5.583**	4.399**	0.614	1.754**
Small shop	2.290**	2.396**		3.610**	3.712**	0.784	3.612**
Fast food	3.405**	5.583**	3.610**		10.773**	0.428**	2.962**
Restaurant	6.014**	4.399**	3.712**	10.773**		1.055	2.020**
Wet market	3.226**	0.614	0.784	0.428**	1.055		1.943*
Street seller	1.415	1.754**	3.612**	2.962**	2.020**	1.943*	

Note: \* p<.05 (Two-Sided Pearson Chi-Square Test), \*\* p<.01 (Two-Sided Pearson Chi-Square Test)

## Conclusions

This paper identified some novel patterns in the food sourcing behaviour of households in Nanjing. While fast food outlets, online food retailers and restaurants were not commonly accessed by households, those that did patronize these sources did so frequently. They tended to have a greater diversity of food sources and to access each source with similar frequency. On the other hand, although supermarkets and wet markets are very common food sources for households and are frequently accessed, patrons of these food sources tended to have a lower diversity of food sources. But there did not appear to be a strong association between the frequency with which households accessed supermarkets and wet markets, indicating that these food sources may be accessed for different purposes. These findings may also indicate different consumer profiles in Nanjing, with some sections of the population favouring access to prepared food on a frequent basis while other sections favour frequent access to fresh food outlets.

One explanation for the phenomenon of household access to online market shopping, fast food and restaurants may be the demographics of the household head. Households that had accessed these food sources in the previous year tended to have heads who were younger and possessed post-secondary qualifications. Other household demographics (like household size and structure) did not seem to have a substantial impact on food sourcing behaviour. This finding contrasts with Yoo et al's (2006) finding that education level was positively associated with restaurant access and negatively associated

with convenience store access. The high frequency of access to wet markets may arise from the types of food that are being purchased at these markets. Si et al (2018) found that households in Nanjing tend to purchase raw vegetables at wet markets, stemming from a desire for fresh over prepared food. Processed foods tended to be bought in bulk, requiring more infrequent food sourcing.

While this research identified the patterns of cross-platform shopping behaviours used by households in Nanjing, future research will be needed to determine the drivers of these behaviours and whether they align with the motivations identified by Abidin et al (2016) or the categories postulated by Berman and Evans (2010). The different food shopping patterns between different households also indicate the potential influence of demographic and socioeconomic features of households. It will also be interesting to examine to what extent the cross-platform shopping patterns identified apply to other cities. This research did find that, despite the Chinese government attempts to replace traditional food outlets with modern supermarkets (Maruyama et al 2016), wet markets remain a very common food retail source for households in Nanjing.

In conclusion, the complexity of urban food systems can obscure a clear understanding of how food is sourced across the system. This paper provides insights into the broader Nanjing food system by examining the network of food sourcing behaviour of Nanjing households. As a result, it contributes to the scholarship on cross-platform shopping by unveiling food shopping patterns across multiple food sources, including online food markets and mobile street vendors that were rarely covered in

previous studies. These findings give a unique insight into the consumer side of urban food retail in China and the relationships in food source preferences among consumers.

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