Original Article

Trends in Chinese snacking behaviors and patterns and the social-demographic role between 1991and 2009

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This study investigates the dynamic shifts in snacking behaviors and patterns in China. Using four waves (1991, 2004, 2006, and 2009) from the China Health and Nutrition Survey (CHNS), with full socioeconomic and demographic data and 3-day, 24-hour dietary recall data, 45,402 individuals age two and older were studied. Multiple logistic regressions were performed to examine the association of social-demographic factors on snacking behaviors. Results show that snacking prevalence, frequency of daily snacking occasions, and percentage of total daily energy intake (EI) from snacks increased significantly across all ages between 1991 and 2009, with a dramatic increase after 2004. Snacking was much more prevalent among children and higher-income, urban, and educated populations over time. Evening was the preferred snacking occasion, and the proportion of total daily EI from snacks varied between 4.1% and 12.3% for all snackers. Fruits, grains, and beverages were the most popular snacks and the highest contributors to snacking EI over all age groups. A marked transition from a tradition of two or three meals per day toward meals combined with snacks is underway. Further research is needed to develop a better understanding of the nutritional implications of Chinese snacking behaviors.

Key Words: snacking behaviors, snacking patterns, Chinese, social-demographic factors, trend

INTRODUCTION

A number of major dietary behavior shifts have been noted across the globe. Snacking is one shift that has received extensive attention partially because of the large amounts of salt, sugar, and fats consumed in snack foods in some countries. Also some scholars noted that snacking behaviors linked with obesity, although this relationship is inconsistent across studies.[1–18] An increased number of daily snacking occasions,[19–22] preferences for high-energy-density and low-nutrient-content snack foods (cakes, cookies, savory snacks, sugar-sweetened soft drinks, etc.),[1,9,17,23,24] increased portion sizes of snack foods,[1] a lack of compensation for energy intake (EI) from snack consumption,[17] and a passive overconsumption due to less satiation from liquid snacks[25] all pose the risk of overweight and obesity.

Recent literature systematically examined the long-term trends of snacking behaviors and snacking patterns among the US population in 1997–1998 and 2003–2006.[21,22] It documents an increase in snacking prevalence (from 71% to 97% for adults, and 78% to 94% for children), an increase in the frequency of snacking occasions (an increase of 0.97 events for adults), and an increase in the contribution of snacks to total EI (24% for adults and 27% for children in 2003–2006). Salty snacks, desserts, candy, and sweetened beverages are the major sources of energy from snacks. Selected studies from other developed countries have explored the current status or trends in snacking behaviors and patterns.[1,20-23,26,27]

Dietary intake patterns, levels of obesity, and related cardiometabolic problems are rapidly changing in China.[28-31] Large shifts in the structure of the Chinese diet have been shown in many studies. These shifts include increases in the consumption of edible oils and animal-source foods, reductions in grains and vegetables,[32-34] and increases in fried foods.[35] A few studies have examined child and adolescent snacking behaviors.[36-38] One study suggests that fruit was a major component of snacking in children ages 6 to 18 between 1991 and 1997.[37] Studies have not examined snacking behaviors in depth and have not focused on the overall nutritional impact of snacking.

This paper investigates trends in Chinese snacking prevalence between 1991 and 2009, and the social-demographic impacts on snacking behaviors. Further, it examines shifts in snacking patterns among Chinese snackers, including average daily snacking occasions, contribution of snacks to total EI, and types of foods consumed as snacks.

MATERIALS AND METHODS

Study design and sample

The study uses four waves of data collected in 1991, 2004, 2006, and 2009 through the China Health and Nutrition Survey (CHNS). Initiated in 1989, the CHNS, an ongoing

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open cohort, was designed to examine how the socioeconomic transformation of Chinese communities and society affects the eating behaviors and nutritional status of the Chinese population. Detailed information on the CHNS has been described previously.[38-41] Of the 45,402 individuals, age two years and older, with full socioeconomic status (SES) and demographic data and 3-days, 24-hour dietary recall data; 12,504 participated in 1991; 11,126 in 2004;10,526 in 2006; and 11,246 in 2009. Ethical approval was provided by the Internal Review Board of the University of North Carolina at Chapel Hill and the Chinese Center for Disease Control.

Dietary data

Detailed dietary data were collected over three consecutive days by a combination of: weighing household intake of all ingredients and creating household-specific recipes for all dishes, and three consecutive 24-hour dietary recall interviews. The measurement of energy has been validated by double-labeled water to be highly reliable.[42] Variability is low, and the three-day dietary intake at the individual level has been found to be a strong measure of usual intake.[43] Methods for dealing with the measurement of condiments and oils added at the household level are quite precise.[40,44] In the interviews, each respondent was asked the location of the eating event, the location of food preparation, the method of food preparation, and the foods consumed. The key child caretaker provided data for children under age ten.

Definitions of "snack," "snack occasion," and "snacker"

"Snacks" refer to all foods and drinks consumed outside the context of the three main meals (breakfast, lunch, and dinner) and are referred to as morning, afternoon, and evening snacks, which make up the "snack occasions." Due to the lack of the specific time for each event, late-night snacks or multiple snacking events during the morning, afternoon, or evening could not be determined. A person is defined as a "snacker" if he or she consumes any snack during the three days investigated in this study.

Food grouping system

Based on the food grouping system established by the University of North Carolina at Chapel Hill and the Institute of Nutrition and Food Hygiene in China, we categorized foods into eight main food groups: grains, cereals, beans, and nuts and their products; vegetables; fruits; animal foods; beverages; candy, sugar, and other high-sugar foods; fast foods; and others. A Chinese food composition table was used to calculate EI. The proportion of snackers consuming each main food group, and each food group's contribution to snacking EI were calculated over three-day periods between 1991 and 2009, by age group. Moreover, the top five food groups with big changes were categorized into relevant subgroups given their health implications. For example, fruits are divided into fresh or canned fruits and dried fruits, and beverages include alcoholic beverages, calorically sweetened beverages, low-calorie beverages, and milk beverages. The subgroups: high-fat cakes (defined as >10 g of fat per 100 g of food) and low-fat cakes in the main group "grains, cereals, beans, and nuts and their products" are important concerns.

Socioeconomic and demographic data

For each survey year, the variable "age" was divided into five categories: 2-6.9, 7-12.9, 13-18.9, 19-44.9, and ≥45 years. A refined measure of urbanicity on a continuum was used instead of an urban-rural dichotomous classification to present change in urbanization over time.[45] Deflated family income per capita was categorized into tertiles (ie, low, medium, and high income). Education was dichotomized into low level (six years of education or less) and high level (more than six years of education) according to the number of years of attendance at formal schools. Most likely the household head preparing food made food choices for children through age 18, therefore the education of the household head preparing food was used for children through age 18.

Statistical analysis

The Cochran-Armitage test for trend was used to assess shifts in snacking prevalence by age group from 1991 to 2009, and then multiple comparisons tests with Bonferroni adjustment were performed to examine the significance of the difference in snacking prevalence between any two survey years. Pooling the data from 1991 and 2009, and introducing a time indicator variable to indicate the survey year, we conducted logistic regression analysis to examine the association between social-demographic factors and snacking behavior. A likelihood ratio test was used to assess time-income, time-education, and income-education interaction. Analysis of variance/ analysis of covariance, adjusting total EI, and then multiple comparisons with Bonferroni adjustment were used to test the significance of change in the percentage of EI from snacks and the shift in the average number of daily snacking occasions over time. Contribution of food groups to snacking energy was examined by chi-square test. All analyses were performed using SAS 9.2 statistical software, and significance levels of p-value <0.05 were used.

RESULTS

There were significant shifts (p<0.05) in age group and education level distribution between1991 and 2009 (Table 1). Except for an insignificant change for children ages 2-6 and 7-12 between 1991 and 2004, the crude snacking prevalence over a three-day period increased (p<0.05) significantly in all age groups, with a dramatic rise occurring after 2004 (Figure 1).

Logistic regression analysis found that income level, education level, and unbanicity were positively associated with snacking prevalence (p<0.001). Snacking was much more prevalent among children and females (p<0.001). Income-time interaction increased the risk of snacking (p<0.001), while time-education and income-education interactions were not significant (p>0.05)(Table 2).

Shift in contribution of snacking to total daily energy intake among snackers

A significant increase in the percentage of total EI from snacks was found only between 2004 and 2006. In 2009

Table 1. Sociodemographic characteristics of the Chinese population, age 2 and older, from the 1991, 2004, 2006, and 2009 surveys

		1991	2004	2006	2009
Sample size		12,504	11,126	10,526	11,246
Age distribution, y (%)*					
	2-6	9.8	3.6	3.5	3.8
	7-12	11.8	6.6	5.4	5.8
	13-18	10.7	7.5	5.0	4.2
	19-44	42.2	35.0	35.1	32.5
	≥45	25.4	47.4	50.9	53.7
Female (%)		51.0	51.3	51.6	51.1
Urbanicity (median)		43.9	59.0	62.6	64.1
Income/capita distribution (%)					
	Low	33.1	33.5	32.7	33.2
	Medium	34.8	33.8	34.5	33.3
	High	32.2	32.6	32.8	33.5
Education distribution, y (%)*					
	Low (≤6)	52.7	38.1	41.3	42.8
	High (>6)	47.3	61.9	58.7	57.2

*$p<0.05$, chi-square test for each socio-demographic characteristic by survey years.

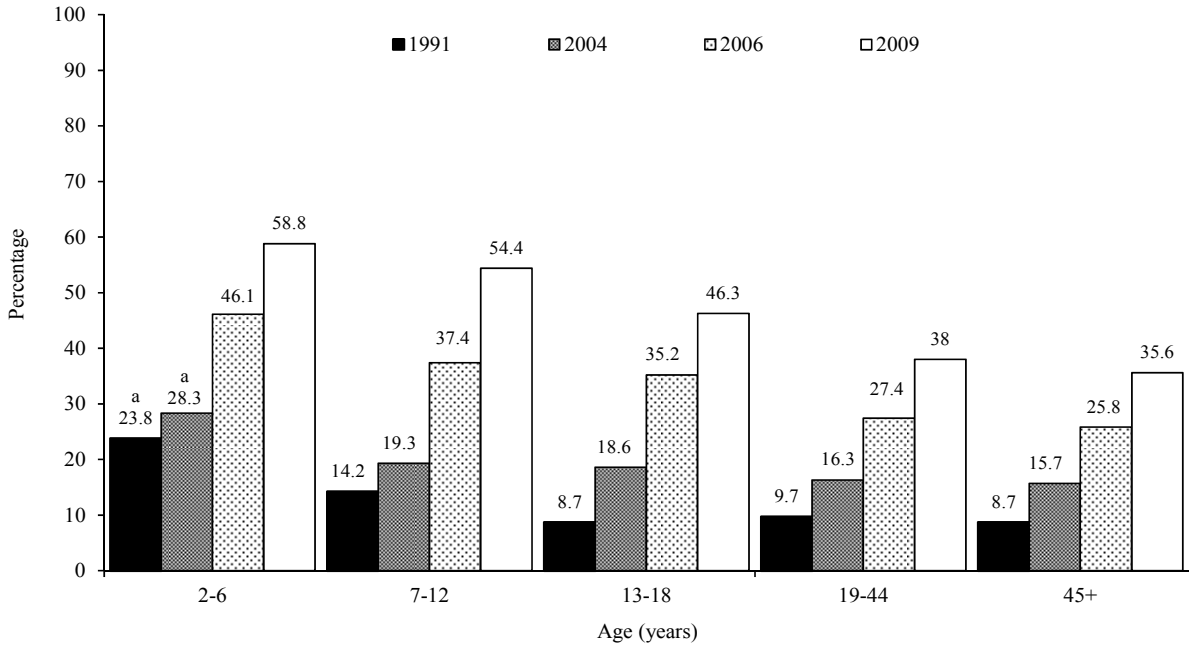

Figure1. Percentage of the Chinese population consuming snacks over a 3-day period, 1991–2009, *p*-trend<0.001 and multiple comparison with Bonferroni adjustment $p<0.05$. [a]no significant difference

snacking represented a percentage of EI that ranged from 12.3% in age 2-6 to 4.0% in adults age 19 and older (Table 3A).

Change in the number of daily snacking occasions among snackers

The number of snacking events increased slightly between 2004 and 2006, among snackers (Table 3B). Evening was the most common snacking occasion, and afternoon was the second most popular snacking occasion over time (unreported results).

Shift in key snack food patterns among snackers

Most interesting is the major increase in the consumption of fruits as snacks (Table 4). For children, the top five contributors to snacking EI were grains, fruits, beverages, fast foods, and animal foods; while adults derived snacking EI primarily from fruits, grains, and beverages.

The decreased proportion of EI from grains due to snacking is attributable to a decrease in consumption of rice, wheat, and high-fat cookies and cakes and an increase in low-fat cookies and cakes. Fruit EI from snacking is mainly from fresh and canned fruits. Milk beverages and sugar-sweetened beverages have significantly increased the EI from beverage snacks (Figures 2 and 3).

DISCUSSION

In China snacking played a small role in the diets of indi-

Table 2. Association of income, education, and demographic factors with snacking (yes-no), CHNS 1991–2009†

Factor	Model1‡		Model2§	
	β	*p*-value	β	*p*-value
Intercept	-2.90	<.001	-2.67	<.001
Year 2004	0.19	<.000	-0.04	0.640
Year 2006	0.88	<.001	0.56	<.001
Year 2009	1.36	<.001	1.12	<.001
Middle income	0.27	<.001	0.14	0.060
High income	0.65	<.001	0.22	0.002
High education	0.25	<.001	0.25	<.001
Age 7-12y	-0.48	<.001	-0.47	<.001
Age 13-18y	-0.90	<.001	-0.91	<.001
Age 19-44y	-1.18	<.001	-1.19	<.001
Age ≥45y	-1.23	<.001	-1.24	<.001
Female	0.22	<.001	0.22	<.001
Urbanicity	0.02	<.001	0.02	<.001
Medium income*year 2004			0.04	0.740
High income*year 2004			0.49	<.001
Medium income*year 2006			0.20	0.040
High income*year 2006			0.61	<.001
Medium income*year 2009			0.18	0.050
High income*year 2009			0.42	<.001
Likelihood ratio test		*p*<.001		

†A person is defined as a snacker if he or she consumes any snack during the three days investigated in this study.
‡Model1 adjusts for only potential confounders with no interaction terms.
§Model2 includes both confounders and significant time-income interaction items (time-education and income-education interactions are not significant; $p<0.05$); the referents in model1 and model2 were the year 1991, low income, low education, male, age 2-6 years.

Table 3. Percentage of EI from snacks and the number of daily snacking occasions among snackers, by age group, over a 3-day period between 1991 and 2009 in China

	1991	2004	2006	2009
A. % of total EI from snacks among snackers†				
Total	4.4‡	3.3§	4.6‡	4.6‡
Age, y				
2-6	9.8‡	9.2‡	12.2§	12.3§
7-12	5.8‡	5.3‡	6.1§	8.5§
13-18	4.5‡	4.2‡	5.5§	6.2§
19-44	2.8‡	2.7‡	4.0§	4.0§
≥45	3.3‡	3.2‡	4.2§	4.1§
B. Number of daily snacking occasions among snackers†				
Total	0.76‡	0.80‡	0.99§	0.95¶
Age, y				
2-6	1.01‡	1.02‡	1.36§	1.18¶
7-12	0.81‡	0.86‡	1.04§	0.98¶
13-18	0.66‡	0.84§	1.03c	0.95¶
19-44	0.66‡	0.72‡	0.91§	0.89§
≥45	0.69‡	0.80§	1.00¶	0.95§

†Data of any two waves specified by different symbols (‡, § or§) are statistically significant ($p<0.05$).

viduals of all ages until 2004. Since 2004, a marked transition in snacking behaviors and patterns has occurred with significant increases in the prevalence of snacking, the number of snacking occurrences in a day, and the contribution of snacks to total EI. This represents more than a doubling of snacking from 2004 to 2009. In 2009, 46.2%-58.8% of children consumed a snack over a three-day period, while about 35.0% of adults snacked. Among snackers, the EI from snacking ranged from 12.3% among younger children to 4.1% among older adults. Interestingly, the largest shift in snacking was toward an increase in fresh fruit consumption.

In contrast to the lower prevalence of snacking over a three-day period in China, in the United States the prevalence was 97% for adults and 94% for children in 2003-2006, with significant increases in 1989-1994 and 1994-2006.[21,22] In China, dramatic increases occurred only after 2004, potentially indicating a major shift in food marketing related to snacking behaviors.

Snacking contributed a lower proportion of EI among snackers in China; in contrast to about 24%-27%in the United States in 2003-2006,[21,22] about 21% in Scotland among children ages 5 to 17 in 2006,[26] and about 35% in adult men and 40% in adult women in Finland in 2002.[23] These differences may reflect the much healthier selection of low-energy-density fruits in China rather than the popular high-energy-density desserts, salty snacks, candies, and sweetened beverages chosen by American

Table 4. Percentage of snackers consuming any food group and its contribution to snacking energy over a 3-day period, 1991 and 2009

Age group	Food group	% of snackers*		Contribution to snacking energy (%)*	
		1991	2009	1991	2009
2-6 y	Grains/cereals/beans/nuts	38.1	21.9	60.7	32.5
	Vegetables	5.5	1.7	0.4	0.3
	Fruits	29.9	35.4	21.6	21.6
	Animal foods	13.0	13.5	5.0	10.5
	Beverages	8.0	17.1	7.7	19.5
	Candy/sugar/other sugar foods	4.5	2.1	3.6	1.9
	Fast foods	0.0	7.9	0.0	10.8
	Others	1.0	0.4	1.1	2.9
7-13 y	Grains/cereals/beans/nuts	37.9	19.2	66.3	30.8
	Vegetables	9.7	1.9	1.0	0.4
	Fruits	36.2	39.7	23.1	23.5
	Animal foods	7.0	12.1	3.1	9.6
	Beverages	5.3	15.6	4.7	19.5
	Candy/sugar/other sugar foods	3.1	2.8	1.8	1.7
	Fast foods	0.0	8.6	0.0	14.6
	Others	0.8	0.0	0.1	0.0
13-18 y	Grains/cereals/beans/nuts	41.0	19.3	67.4	30.6
	Vegetables	12.1	3.1	0.7	0.4
	Fruits	35.8	44.9	21.1	27.8
	Animal foods	6.4	8.6	4.4	6.4
	Beverages	4.6	15.4	6.5	18.4
	Candy/sugar/other sugar foods	0.0	2.1	0.0	1.2
	Fast foods	0.0	6.5	0.0	15.1
	Others	0.0	0.0	0.0	0.0
19-44 y	Grains/cereals/beans/nuts	34.8	15.1	66.0	29.1
	Vegetables	10.0	3.8	0.9	0.7
	Fruits	45.0	65.4	22.1	49.5
	Animal foods	5.6	4.5	5.1	4.5
	Beverages	3.7	9.1	5.4	13.2
	Candy/sugar/other sugar foods	0.9	0.7	0.5	0.4
	Fast foods	0.0	1.3	0.0	2.7
	Others	0.0	0.1	0.0	0.0
≥45 y	Grains/cereals/beans/nuts	31.9	17.6	63.3	28.7
	Vegetables	10.5	4.5	1.0	1.3
	Fruits	44.6	65.1	24.3	53.0
	Animal foods	6.6	2.5	3.5	2.6
	Beverages	3.8	8.9	4.5	12.5
	Candy/sugar/other sugar foods	1.5	0.6	2.7	0.5
	Fast foods	0.3	0.8	0.4	1.5
	Others	0.8	0.1	0.4	0.1

*$p<0.05$, chi-square test for snack food proportions between 1991 and 2009 by age group.

snackers.[1,15, 20-23,26] However, in China the recent increase in popularity of beverages and fast foods as snacks may represent an emerging health concern.

In addition, evening is the most popular snacking occasion among the Chinese population, while afternoon is the most popular among US adults and children.[46] Some studies have assumed that evening or bedtime snacking combined with a sedentary lifestyle may lead to excessive weight gain,[23,47] although research on this topic is inconsistent and limited.[2,6]

One limitation is the measurement of snacking in this survey. Using repeated 24-hour dietary recalls, snacking occasions were limited to morning, afternoon, and evening due to the lack of a specified time for each eating event. For this study, snacking is defined as food consumption outside the three main meals (breakfast, lunch, and dinner). This is similar to the definition used in other studies.[8,9,17,35,37] Furthermore, this measure excludes snack foods consumed during regular meals. Consequently, this is not a study of snack foods but rather of snacking events. Others have used time of day and respondents' self-definitions rather than a food-based classification system.[26]We feel our approach is appropriate given that foods associated with traditional Chinese meals are strictly delineated by the time of day. However, the measurement also limits snacking events to each in the morning, afternoon, and evening respectively, reducing its comparability with other snacking frequency studies, such as those that define snack events as food consumed in a 15-minute period.[1]Our study examines snacking over a three-day period in contrast with others that use varied dietary survey days, such as one- or two-day periods.[8,15] In addition, there is limited information in Chinese food composition table on modern packaged and highly processed snack foods in China, most of which may be high-energy-density, deep-fried, and salty or sweetened foods.

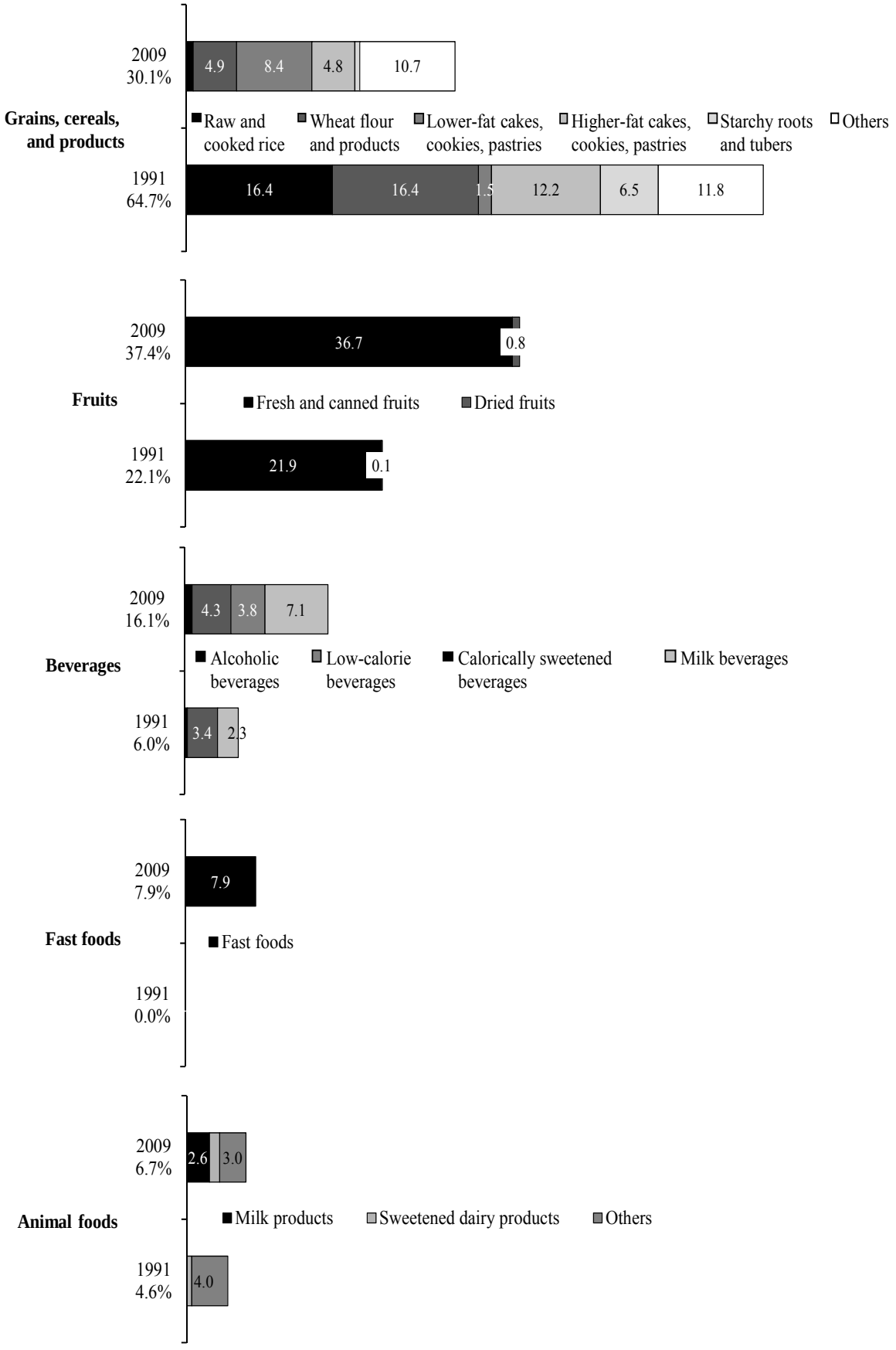

Figure 2. Percentage of energy from main food groups to snacking energy intake among children age 2-18 years, 1991 and 2009

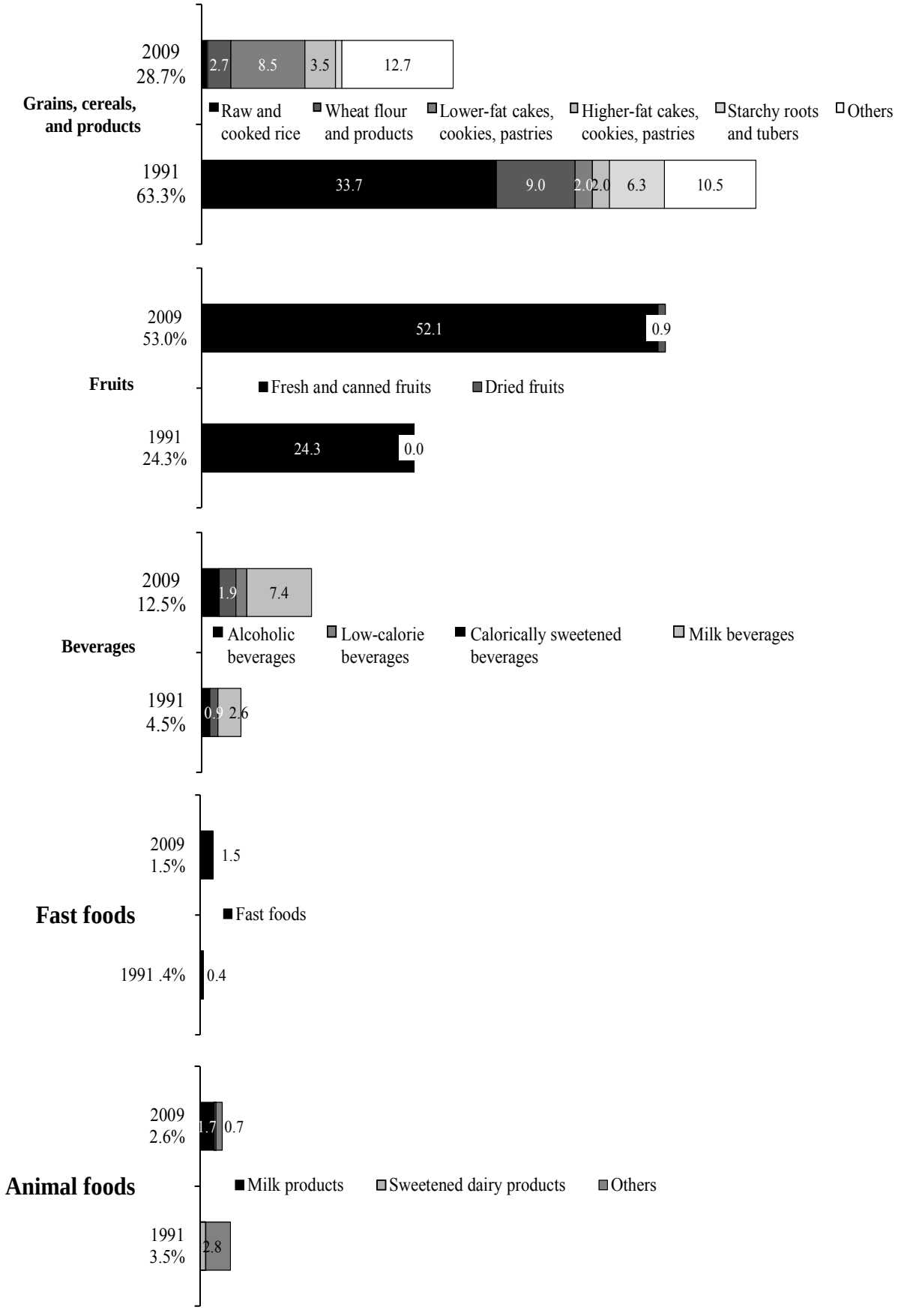

Figure 3. Percentage of energy from main food groups to snacking energy intake among adults age 19 years and older, 1991 and 2009

There is another problem with snacking. As is noted by others, this becomes in many societies a mindless activity which consumers often do not remember well.[48] We will need to do further research to fully understand if there is measurement error in China that might explain why the increase in the percentage of snackers was about 10% while the number of snacking occasions remained stable.

Conclusion

This study shows that the Chinese population is experiencing a dramatic increase in snacking and that a marked transition from a tradition of two or three main meals per day toward meals combined with snacks is underway. Further research should attempt to understand how the marketing of food and other changes in the food system have led to such dramatic changes in eating behavior. The health implications of such a transition in snacking behavior should be further investigated.

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AUTHOR DISCLOSURES

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Original Article

Trends in Chinese snacking behaviors and patterns and the social-demographic role between 1991and 2009

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中國居民 1991-2009 年零食攝入行為和模式的變遷與社會人口因子的角色

本文旨在调查中国居民零食摄入行为和模式的动态变迁。利用中美合作课题“中国健康与营养调查”1991 年、2004 年、2006 年和 2009 年的四轮调查数据，研究对象为 2 岁及以上的人群，且有完整的社会经济和人口数据及连续 3 天 24 小时膳食回顾数据。应用 Logistic 多元回归模型调查了社会经济因素对零食摄入行为的影响。结果显示 1991-2009 年间中国各年龄人群的零食摄入率、每日零食摄入频次、零食提供能量占总能量的百分比均呈显著的增加趋势，自 2004 年后增加极为迅速。零食摄入行为在儿童、高收入人群、高教育水平人群和城市居民中较为盛行。晚餐后是选择吃零食比较多的时间。在选择零食的人群中，零食供能比占总能量的 4.1%-12.3%。水果、谷类和饮料是最经常的零食选择，也是各年龄组人群中提供能量最多的零食种类。本研究表明中国居民传统的每日两或三餐正在向每日正餐和零食摄入共存的模式变迁。零食摄入行为和模式的变迁对中国居民营养状况的影响有待进一步深入研究。

關鍵字：零食攝入行為、零食模式、中國人、社會人口因素、趨勢