The food retail revolution in China and its association with diet and health

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ARTICLE INFO

ABSTRACT

The processed food sector in low- and middle-income countries has grown rapidly. Little is understood about its effect on obesity. Using data from 14,976 participants aged two and older in the 2011 China Health and Nutrition Survey, this paper examines patterns of processed food consumption and their impacts on obesity while considering the endogeneity of those who purchase processed foods. A major assumption of our analysis of the impact of processed foods on overweight and obesity was that the consumption of processed foods is endogenous due to their accessibility and urbanicity levels. The results show that 74.5% of participants consumed processed foods, excluding edible oils and other condiments; 28.5% of participants' total daily energy intake (EI) was from processed foods. Children and teenagers in megacities had the highest proportion of EI (40.2%) from processed foods. People who lived in megacities or highly urbanized neighborhoods with higher incomes and educational achievement consumed more processed foods. When controlling for endogeneity, only the body mass index (BMI) and risk of being overweight of children ages two to eighteen are adversely associated with processed foods (+4.97 BMI units, 95% confidence interval (CI): 1.66–8.28; odds ratio (OR) = 3.63, 95% CI: 1.45–9.13). Processed food purchases represent less than a third of current Chinese food purchases. However, processed food purchases are growing at the rate of 50% per year, and we must begin to understand the implications for the future.

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Introduction

Across low- and middle-income countries (LMICs), diets have transformed greatly. An important factor in recent changes appears to be the modern retail food sector (Monteiro and Claro, 2013; Monteiro and Cannon, 2012; Popkin, 2014; Popkin et al., 2012). Asia is in the midst of a major shift in food sources and in the way foods are processed, packaged, and purchased (Minten et al., 2010; Reardon et al., 2014, 2012). In Latin America the shift from fresh markets as primary food sources began earlier (Reardon and Berdegué, 2002; Reardon et al., 2003), and now over half of the caloric intake of Mexicans and others in Latin America may be from packaged and processed foods (Popkin, 2014). These changes have occurred much more recently in Asia (Garnett and Wilkes, 2014; Popkin, 2014; Reardon et al., 2009, 2014, 2012; Wang et al., 2009; Zhang and Pan, 2013). T. Reardon and others have defined three waves in Asia, the first affecting Korea and Taiwan; the second reaching Indonesia, Malaysia, the Philippines, and Thailand; and the third and most recent affecting China and India (Reardon et al., 2014, 2012). To date, a number of studies have noted the potentially adverse effects of highly processed foods on diet and health, but little research has focused on the potential relationship of actual dietary intake and the changing sources of foods and beverages with health in LMICs.

The most widely cited arguments are that the retail revolution makes ultraprocessed foods high in sugar, fat, and sodium readily available and that the major global food and beverage companies have led this change (Ludwig, 2011; Monteiro and Claro, 2013;

Monteiro and Cannon, 2012; Monteiro et al., 2011; Moss, 2013). Much of the work examining this development has been general or has used food expenditure surveys or food balance data from the Food and Agriculture Organization of the United Nations. Others have used sales information in the Euromonitor Passport Global Market Information Database which is highly aggregated (Baker and Friel, 2014; Monteiro and Claro, 2013; Monteiro et al., 2013; Moodie et al., 2013). One cross-sectional study in Guatemala that linked the intake of processed foods with body mass index (BMI) found that higher levels of consumption of processed foods was linked with increased BMI and risk of overweight and obesity (Asfaw, 2011). However, the Living Standard Measurement Survey data did not provide the detailed data needed to precisely categorize food purchases into processed and unprocessed foods and to link them with individual BMI values. He did use similar instrumental variables to model this relationship.

To date, packaged food purchase patterns, sources, and health impacts on consumers are little understood. Some studies in developed countries have linked processed foods with higher energy density intake, higher salt and sugar consumption, and lower dietary fiber intake (Baillie, 2008). As a result, eating processed foods is associated with higher energy intake (EI) or an increased prevalence of obesity and overweight (Cutler et al., 2003; de Graaf, 2006; Pereira et al., 2005). While these authors have not addressed causal factors, the nutrition literature posits that three primary dimensions of processed foods are potentially linked to increased EI and subsequent weight gain. First, the highly refined nature of most processed foods gives them a low glycemic index with all the related biological effects associated with such foods (Lennerz et al., 2013; Ludwig, 2002; Pereira et al., 2004). Second, these foods generally are higher in added sugars and are linked with excessive weight gain, particularly related to beverages (Malik et al., 2013; Morenga et al., 2013, 2014). Third, higher fat content in processed foods and the link between fat and weight gain are increasingly controversial today (Bray and Popkin, 1998; Willett, 1998).

Studies of processed food consumption in China are limited. Supermarkets and convenience stores, which are the main sources of processed foods, have been expanding rapidly and are changing the profile of China's food supply (Hu et al., 2004). Previous data have indicated that the processed food industry's retail sales are increasing quickly in China (Wang et al., 2011). However, no individual-level consumption data have been available. Our research began with a premise that households that purchase and consume processed foods may differ systematically from those that do not. We used instrumental variable techniques to correct the potential correlation between the error term of the body weight equations and the consumption of processed food through unobservable individual, household, or community factors. We have two sets of valid endogenous instruments, namely, each household's distance to grocery stores and to free markets selling processed foods and urbanicity levels. Free markets are a term used in China to differentiate all the private sector stores from the state stores that existed for many decades and disappeared during the 1990s. These are the term still used in the community questionnaire as that is the way most respondents think of these stores. The most likely unobservables are genetic, mainly tastes for processed foods which may be higher sweet or fatty or salty food presence, but they may also be unmeasurable perceptions that these are higher status foods to purchase and eat.

The Euromonitor reports that retail sales and per capita purchases of processed food increased between 1999 and 2013 in China. They were four times higher in 2013 than in 1999 for 22.4% annual growth over the fifteen-year period (Fig. 1). Euromonitor data show that over half of the packaged foods sold in China's markets was processed foods. We defined packaged, processed foods according to the data collected by the Euromonitor
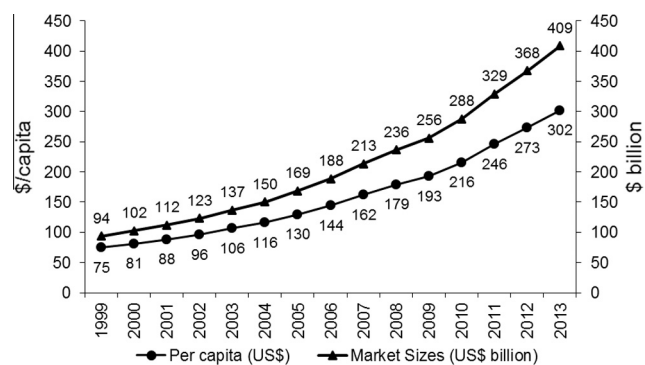

Fig. 1. Processed food retail values in China, 1999–2013 (fixed 2013 exchange rate). *Source:* Euromonitor Passport Global Market Information Database.

Passport Global Market Information Database (Euromonitor 2013), including foods available at all retail sales and food services in stores, restaurants, or other food stands, such as processed food, chilled processed food, frozen food, dried food, snacks, baby food, bakery items, canned and preserved food, dairy items, ice cream, meal replacements, ready-made meals, and others.

This study used one wave of the longitudinal China Health and Nutrition Survey (CHNS) from 2011 to examine both the sources of and the intake patterns of packaged and processed foods. Furthermore, controlling for the endogeneity of processed foods and beverage purchases, we examined the relationship of the consumption levels of these foods and beverages with BMI levels and the risk of being overweight.

Methods

Sample and study design

We used data from 14,976 respondents aged two and older in the 2011 CHNS, a nationwide, ongoing, open cohort study that we initiated in 1989 and have subsequently implemented. The CHNS is conducted in nine diverse provinces from the Northeast to the Southwest (Heilongjiang, Liaoning, Jiangsu, Shandong, Henan, Hubei, Hunan, Guizhou, and Guangxi) and three politically autonomous megacities (Beijing, Shanghai, and Chongqing). We used a multistage, random cluster process to randomly draw the sample surveyed in each of the provinces and megacities. We selected two cities and four counties in each province, four communities in each city or county, and twenty households in each community, all randomly selected. All communities were stratified by income and selected on a probability proportional to size basis. At the local level we developed detailed rosters of all residents. We interviewed all household members present over a three-day period and returned on weekends to collect data from students who went to towns or cities for school during the week. The design, sampling, and response rates have been reported previously (Popkin et al., 2010). The institutional review boards of the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention, approved the research protocols and instruments and the process for obtaining informed consent for this study. Study participants provided their written, informed consent.

Diet measurement

We collected detailed diet data at the household level and at the individual level using weighing methods in combination with