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Research report

## Associations between eating occasions and places of consumption among adults <sup>☆</sup>

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## ABSTRACT

The objective of this study was to determine whether places of consumption are associated with types of eating occasions. Data on dietary behaviors of 226 adults in five U.S. cities were collected in food diaries for one week. Types of eating occasions and places of consumption were recorded. Eating occasions were defined as occurrences of meal, snack, beverage, and non-fruit dessert consumption. Nearly one-third of eating occasions occurred at non-designated eating places. Repeated measure generalized linear models were used to assess the associations between types of eating occasions and places where food was consumed. Snacking on low-nutrient foods were more likely to occur in non-designated eating places. Snacking was more likely at work than at home, and sugar sweetened beverage consumption was more likely at food service outlets than at home. The finding that places of consumption were associated with different types of eating occasions suggests that contextual characteristics of a place are important in individual eating behaviors. Policies and programs aiming to promote healthy eating should leverage contextual characteristics of eating environments.

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## Introduction

Diet and nutrition are important contributors to population health and chronic disease risk (Healthy People 2020, 2014; National Prevention Strategy, 2011). Trends in dietary patterns over the last few decades include increased food consumption away from home, at fast food outlets, and of sugar sweetened beverages (Briefel & Johnson, 2004; French, Story, & Jeffery, 2001; Ma et al., 2003). In addition, snacking has increased in prevalence and consumption of high-sugar, high-fat content snack items are associated with obesity (Berteus Forslund, Torgerson, Sjostrom, & Lindroos, 2005; Piernas & Popkin, 2010). Analyses of National Health and Nutrition Examination Surveys (NHANES) have attributed increased total energy intake to changes in energy density, portion size, and the number of eating occasions, where an eating occasion was defined as a meal or snacks/beverages consumed within 15 minutes (Duffey & Popkin, 2011). Although there is evidence of changing dietary content and food away from home, the setting where

people eat and how the contextual factors of the setting are related to what people eat are not as well-characterized.

Eating behavior involves a myriad of complex influences. Social cognitive theory suggests that behavior is reciprocally influenced by cognition and environment (Glanz & Bishop, 2010). Under this theory, self-efficacy is important for an individual to change behavior; however, individuals also respond to environmental changes. In this vein, studies have examined diet as an automatic or habitual behavior, whether conscious or not, that can be influenced by contextual factors such as within-place food accessibility, food labeling, atmosphere, and social situations (Cohen & Farley, 2008; Khare & Inman, 2006). Wansink describes such factors of an eating environment as atmospheric, effort, eating with others, and distractions (Wansink, 2004). The physical environment includes atmospheric factors such as light, temperature, sound, and smell. Effort refers to the accessibility and convenience of food, which is also part of the physical surroundings. For example, the placement of chocolate on one's desk versus two meters away can result in increased consumption (Painter, Wansink, & Hieggelke, 2002). Eating in the presence of others can lengthen the duration of eating and socialization can provide cues to eat more or less than one might have if eating alone (Clendenen, Herman, & Polivy, 1994; de Castro, 1994; Redd & de Castro, 1992). Lastly, numerous studies have demonstrated that distractions can greatly limit people's cognitive ability to consciously respond to stimuli, which can lead to impulsive or mindless eating (Stroebele & De Castro, 2004). One often cited example is the Shiv and Fedorikhin experiment in which participants who were asked to memorize a seven-digit number rather

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than a two-digit number were more likely to select a snack of chocolate cake rather than fruit salad (Shiv & Fedorikhin, 1999). Thus, both the physical and social environment can influence the type and amount of food consumed. The place of consumption, whether it is a cafeteria, restaurant, workspace, dining table, or couch in the living room, the availability and accessibility of food at that place, and other contextual factors could affect the type and amount of food that ends up being consumed (Cohen & Babey, 2012). The effect of environmental factors such as social facilitation has been characterized in many studies, while some other factors have been examined only in laboratory settings or within limited observational studies (Stroebele & De Castro, 2004). Further insight into the influence of the home or work environment on adult eating behaviors can inform healthy eating interventions.

This study aims to assess where people eat, and whether the setting is related to consumption and the type of food consumed. We examined whether the designation of a place as primarily intended for eating or not intended for eating is associated with more frequent eating occasions and unhealthy food. Food consumption at a non-designated eating place may be a proxy for eating when constrained for time or eating as a secondary behavior, e.g., snacking in front of the television or at a workspace. We hypothesize that eating under such conditions may be related to unhealthy food consumption.

## Methods

### Study sample

The data were collected as part of a study of neighborhood parks in which 241 individuals were recruited primarily from neighborhood parks in five U.S. cities between May 2009 and April 2011 (Evenson, Wen, Hillier, & Cohen, 2013). The participants were a non-random sample from Los Angeles, California (CA); Chapel Hill, North Carolina (NC); Columbus, Ohio (OH); Philadelphia, Pennsylvania (PA); and Albuquerque, New Mexico (NM). Further details regarding participant recruitment and data collection are published elsewhere (Evenson, Wen, Golinelli, Rodriguez, & Cohen, 2013; Evenson, Wen, Hillier, et al., 2013). Briefly, participants were weighed on a digital scale and heights were measured with a stadiometer at recruitment. Participants wore ActiGraph accelerometers (GT1M) and GPS monitors (Qstar BT-Q1000X) that measured physical activity and location data in one-minute intervals for three weeks. For the last week of the study, participants recorded all places visited and the types of food consumed there, using a travel and food diary log on a personal digital assistant (PDA). Of the 241 participants recruited, 15 were not analyzed in the present study due to missing data. Thus, the analysis sample here consists of 226 participants.

### Food diary

The PDA responses in the diary were guided by a series of questions accompanied by a list of responses from which the participant could choose. The first set of questions asked the participant to record the time arrived, type of place, and transportation mode. The types of place included home, work, sit-down restaurant, fast food/convenience store, grocery/supermarket, mall/store, someone else's home, park, place of worship, community activity facility, and other. The transportation modes included walk, bike, car, and mass transit. Questions that included "other" as a response gave the participant the option to write in a response.

The next set of questions was on the consumption of meals, non-fruit desserts, snacks, and beverages. Meals were recorded as check-box selections of breakfast, lunch, dinner, and other. Participants indicated whether they had a non-fruit dessert with the meal. Check-box selections for snacks were candy, cookies and pastries,

chips or other salty snack, fruit, vegetables, frozen dessert, dairy products like yogurt, deep fried food, other, and none. Check-box selections for beverages were coffee or tea, sugar sweetened beverage, diet drink, 100% juice drink, milk/soy milk/yogurt drink, alcohol, water, other, and none.

Lastly, participants were asked to describe whether the eating place they ate or drank at was a designated eating place, non-eating place, or in transit. Participants were instructed to consider designated eating places as places primarily meant for eating, such as dining areas, and non-eating places as places not primarily designated for eating, such as a desk at work or a living room. Training and verbal explanations were provided to participants prior to the diary period.

### Definition of eating occasions

In this paper, an eating occasion was defined as an instance of a meal, snack, beverage, or non-fruit dessert recorded in the food diary. Only non-fruit dessert occasions that did not coincide with a meal were counted as an additional eating occasion in the total number of eating occasions. Snacks were classified as healthy, unhealthy, and other snack occasions. Healthy snacks included fruit, vegetables, and dairy products like yogurt. Unhealthy snacks included candy, cookies or pastries, chips or other salty snack, frozen dessert, and deep fried food. Written responses under the "other" option for snacks were categorized as healthy, unhealthy, and other snacks by the authors based on the similarity of written description with the aforementioned snack items. Snack items per diary entry were grouped into occasions of healthy, unhealthy, or other snack consumption. For example, if a participant had both fruit and vegetables in one diary entry, this would count as one eating occasion of a healthy snack. If a participant had fruit and cookies in one diary entry, this would count as two eating occasions – one healthy snacking and one unhealthy snacking occasion. All beverages except for water were counted as eating occasions. As each diary entry reflected a trip to a single destination, multiple eating occasions may have occurred with each entry.

### Accelerometer

Participants were instructed to wear the accelerometer and GPS devices starting in the morning when they woke up and to remove it when they went to sleep. The accelerometer counts were previously pre-processed to exclude unreliable measurements (Evenson et al., 2013). Periods of at least 20 minutes when the accelerometer recorded zeros were considered non-wear time. Accelerometer counts during non-wear time were set to missing. Additional data processing was performed in R version 2.15.1 (R Foundation for Statistical Computing, Vienna, Austria) to remove duplicated records. In this paper, time spent in moderate to vigorous physical activity (MVPA) is described as the average minutes per day above 2020 counts/minute, based on the intensity thresholds used by Troiano and colleagues (Troiano et al., 2008). Average MVPA for each participant was calculated by summing the total number of minutes above 2020 counts/minute and dividing by the total wear time expressed as days and fractions thereof. Wear time was defined as the total time with valid accelerometer and GPS data.

### Statistical analysis

Descriptive statistics were calculated to summarize the eating occasions by type and place of consumption. Generalized linear models were used to estimate associations between eating occasions and the places of consumption. To account for the strong intraclass correlations within each subject due to repeated measures,

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