



Contextual and environmental influences on reported dietary energy intake at evening eating occasions



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ABSTRACT

Objective: This study sought to determine the simultaneous effect of immediate eating environment variables; portion size, plate size, proximity to food, variety of food, side serves of salad/vegetables and presence of distraction on dietary energy intake (EI), of a reported evening meal, in the participants' real world setting.

Design: A retrospective computer assisted telephone interview collected data on ten immediate eating environment variables, covariates and a 24-hour dietary recall of EI at an evening meal. Multiple regression analysis was conducted to determine relationships of these variables with EI. Significant ($P < 0.05$) standardised beta coefficients (β) are reported.

Setting: Australia wide, participants' homes.

Subjects: Australian adult males and females ($n = 150$) aged 18–65 years.

Results: Of the immediate eating environment variables, the absence of salads/vegetables ($\beta = 0.237$), increased food variety ($\beta = 0.208$), presence of music ($\beta = 0.207$), and the consumption of pre-plated (as opposed to self-served) meals ($\beta = 0.195$) had a positive association with EI, explaining 16.3% of the variance. Of the covariates, being male was the strongest predictor of EI ($\beta = 0.242$); and hunger score also had a positive relationship with EI ($\beta = 0.190$), explaining 17.5% of the variance.

Conclusion: This study provides evidence that some immediate food environment variables at an evening eating occasion are associated with EI. Findings suggest there are several strategies that people could implement to assist in controlling their EI and help address over consumption.

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1. Introduction

Obesity is a worldwide issue, with the rates doubling globally since 1980 (World Health Organisation, 2014). For example, about 60% of Australian adults are overweight or obese (Australian Bureau of Statistics, 2013). Weight gain is the result of energy imbalance, where energy consumed outweighs energy expended (World Health Organisation, 2014), and in our current “obesogenic” environment gradual overconsumption is becoming the norm (Swinburn, Egger, & Raza, 1999).

It has been stated that ‘the eating behaviour of humans in their natural environments is complexly affected by a myriad of nutritional, physiological, psychological, sociological and cultural factors’ (De Castro, 1996). Some researchers have defined these factors within models or frameworks. For example, the Analysis Grid for Environments Linked to Obesity (ANGELO) model introduces two overarching environments that influence food intake: the macro-environment, which includes the infrastructure and built environmental factors

that influence production and distribution of food; and the micro-environment, which includes places in which people gather for a purpose (e.g. eating), such as homes, workplaces and recreational places (Swinburn et al., 1999). A key review paper describes this micro-environment level even further, conceptualising two distinct categories, the eating and the food environments (Wansink, 2004); while others have included a third category: the characteristics of the individual (Meiselman, 1996). Indeed individual characteristics, such as socio-demographics or personality traits, may confound the influence of environmental variables and should be controlled in such investigations. These three categories can be conceptualised into layers around an eating occasion, and broken down further into the different variables that influence what and how much we eat, and ultimately the amount of dietary energy consumed (Fig. 1).

Of these contextual categories, the eating environment is the focus of this paper, as it is the layer containing variables that can potentially be controlled by an individual to influence his or her own food intake. Although there is extensive research on a range of these eating environment variables, using various outcome measures (e.g. grams of food, money spent, duration of eating) minimal research investigates the specific individual and interrelated effects of the eating environment on dietary energy intake (EI). Literature suggests five possible drivers

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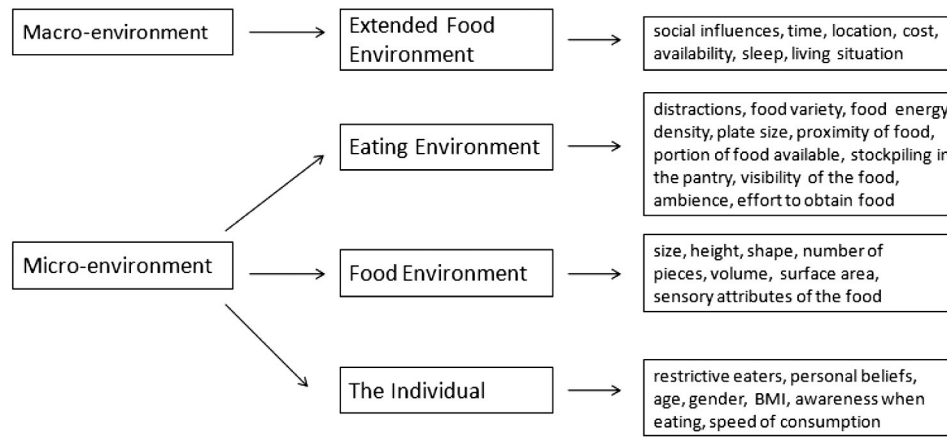


Fig. 1. Conceptual model of potential influential variables on dietary energy intake within categories in the macro- and microenvironment at an eating occasion.

of EI within this layer: portion size, plate size, proximity, a variety of food and presence of distractions.

Portion size has been shown to be a key driver of EI at a main meal (Levitsky & Youn, 2004; Diliberti, Bordi, Conklin, et al., 2004). Food variety at an eating occasion also appears to increase intake; however, variety appears to be confounded by the energy density of the foods, as it has been shown that variety does not increase EI when referring to a variety of vegetables, which have a low energy density (Rolls, Roe, & Meengs, 2010; Kral, Roe, & Rolls, 2004; Norton, Anderson, & Hetherington, 2006; Raynor & Osterholt, 2012). A larger plate size has been shown to increase EI for snack foods but not necessarily energy consumed at a main meal (Wansink & Cheney, 2005; Marchiori, Corneille, & Klein, 2012), and the proximity to food at a main meal (i.e., the distance to additional food) may also influence food choice and consumption (Privitera & Zuraikat, 2014). Another eating environment factor is the presence of television – thought to be a distraction to the eating experience and potentially result in passive overconsumption of energy (Bellisle, Dalix, & Slama, 2004; Bodenlos & Wormuth, 2013; Martin, Coulon, Markward, et al., 2009). These findings suggest other screen devices and auditory stimuli (Bellisle et al., 2004) including music (Stroebele & de Castro, 2006), which are becoming more common, are worth exploring as potential distractions.

While there is evidence that factors from within an individual's eating environment can influence consumption, there is heterogeneity in approaches used to assess their influence making it difficult to summate the strength of these relationships. For example, studies tend to measure one factor (Privitera & Zuraikat, 2014) and not the sum of multiple factors from within an eating environment often occurring simultaneously; use university student samples (Wansink & Cheney, 2005); have differing outcomes of intake and rarely measure EI. Previous studies also differed in the number of potential confounders measured. Furthermore, no peer-reviewed published studies have investigated the effect of these on EI within the context of a real world eating occasion (i.e. outside of a laboratory) (Marchiori et al., 2012; Braude & Stevenson, 2014). As EI is directly related to weight management, determining the individual and interrelated impact of these variables on EI may allow identification of the more influential contextual variables on a person's eating behavior and provide insight into the problems related to obesity. The layers of categories (Fig. 1) are likely to be inter-related (Swinburn et al., 1999; Wansink, 2004) hence key individual characteristics including age, gender, dietary restraint, body mass index (BMI), hunger and fullness ratings were also considered as potential co-variables (Rolls, Roe, & Meengs, 2006) in this study.

The aim of the current study is to identify whether the eating environment variables of portion size, plate size, proximity, variety of food, side serves of salad/vegetables and presence of distraction are associated with EI at an evening eating occasion in a real world setting. It is

hypothesized that increasing portion size, plate size and proximity, the absence of vegetables and the presence of distraction at an eating evening occasion will all be positively associated with EI.

2. Methods

2.1. Study participant inclusion and exclusion criteria

Participants were required to be an adult Australian resident (for at least 3 years); living independently (e.g., not in a residential or nursing home); and proficient in English. Exclusion criteria focussed on factors likely to alter EI and were any one under the age of 18 years and over the age of 65 years; living in an institution (e.g. residential care, student residences), on a diet to lose or gain weight, on medications that alter appetite, not regularly eating an evening meal each day, and being pregnant or breastfeeding.

2.2. Sampling

Recruitment was initially undertaken via a status update on our laboratory's Facebook page with a link directing interested people to the information sheet and screening questions. Once participants gave informed consent and contact details, they were contacted via text message in the evening to inform them they would be called the next day to complete the Computer Assisted Telephone Interview (CATI). A protocol for contacting CATI non-responders was implemented to minimise drop-out rates during the data collection phase. All participants were given a \$10 retail voucher to thank them for their time.

2.3. Design

A retrospective telephone interview was used to collect information about participants' last evening meal.

To determine EI an adapted version of a validated three-pass 24-hour dietary recall protocol was used to assess energy intake consumed at the previous night's evening meal (Hendrie & Bowden, 2009). The main evening meal was the focus of the study as this eating occasion usually contributes most energy and has the largest potential for variation (Cox, 2009). Analysis of the dietary recall of the evening meal intake was conducted using Foodworks Professional Edition (Version 7, Xyris Software, Highgate Hill, Australia) and the data exported to SPSS version 20 for Windows (IBM Corp, Armonk, NY) for analysis. Predictor variables such as information about the preparation of the meal (self-prepared or not), timing of previous food intake, how many people ate together were also collected as part of the CATI (Wansink, 2004; Wansink & Cheney, 2005). A template was used to guide the interviewer and included a series of questions about

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