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Educational nutrition messaging at breakfast reduces snack intake and influences snack preferences in adult men and women

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ABSTRACT

Breakfast skipping is associated with increased risk of weight gain and obesity in young adults, possibly due to increased snacking later in the day. Recent research suggests that providing and animal versus a plant source of protein at breakfast can reduce snack intake later in the day. In addition, providing nutrition information via a nutrition label, front-of-pack information, or via text messaging has been shown to help individuals make healthier food choices. The objective of this study was to determine if educational nutrition messaging and protein source influenced snack intake 2 h following the breakfast meal. Participants (n = 33) were randomly assigned to one of two groups: educational nutrition messaging (EM; n = 16) or no messaging (NM; n = 17) group. The study was conducted using a randomized, cross-over design in which each participant received each of two breakfast beverages, whey protein- (WP) and pea protein (PP)- based. Appetite was assessed at 0, 15, 30, 60, 90, and 120 min after each test breakfast using visual analog scales. Participants were then provided with a selection of healthy and unhealthy snacks for 60 min. There was no effect of protein source on appetite or snack intake. However, participants presented with EM had reduced snack intake over the snacking period compared to NM ($P = 0.058$) and, of the snacks consumed, the EM group consumed a higher percentage of healthy versus unhealthy snacks compared to NM ($P < 0.0001$), resulting in lower calorie intake. Taken together these data suggest that protein source, as part of a higher protein breakfast, does not affect appetite response or snack intake, but EM may help play a role in reducing snack intake between meals.

1. Introduction

Over the last 20 years there has been a dramatic decline in breakfast consumption, paralleling the increase in obesity. Nearly 40% of American adults, 32% of children ages 8–14 years, and 30% of adolescents ages 15–18 years (Rampersaud, Pereira, Girard, Adams, & Metzl, 2005) skip breakfast on any given day (McCrory, 2014), despite the proven health benefits associated with eating breakfast such as increased feelings of fullness, reduced post-meal cravings (Alwattar, Thyfault, & Leidy, 2015; Bauer et al., 2015; Hoertel, Will, & Leidy, 2014; Leidy & Racki, 2010; Park et al., 2015; Rains, Leidy, Sanoshy, Lawless, & Maki, 2015), improved body composition (Leidy, Hoertel, Douglas, Higgins, & Shafer, 2015), and a decreased incidence of overweight and obesity (P. Deshmukh-Taskar, Nicklas, Radcliffe, O'Neil, & Liu, 2013; P. R. Deshmukh-Taskar, Radcliffe, Liu, & Nicklas, 2010).

Data suggest that it is not only the frequency of breakfast, but the quality of breakfast (e.g., macronutrient composition) that is essential for appetite and blood glucose control, potentially reducing the risk of developing obesity and type 2 diabetes (Pereira et al., 2011). Among breakfast consumers, the consumption of protein-based products at breakfast has decreased and the consumption of dietary carbohydrates at breakfast has significantly increased over the last fifty years (Haines, Guilkey, & Popkin, 1996; Vander Wal, Gupta, Khosla, & Dhurandhar, 2008). Consuming more protein (20–30 g) at breakfast than found in the standard cereal-based breakfast (10–15 g) may increase subjective feeling of fullness and satiety throughout the day (Ratliff et al., 2010; Vander Wal et al., 2008) and decrease calorie intake at lunch (Ratliff et al., 2010).

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Abbreviations

BMI	Body mass index
EM	Educational nutrition messaging
niAUC	Net incremental area under the curve
NM	No educational messaging
PP	Pea protein
VAS	Visual analog scale
WP	Whey protein

However, some research suggests that plant-based proteins, such as pea and soy proteins, are not as satiating as animal-based proteins, such as whey and casein, in the short-term (Abou-Samra, Keersmaekers, Brienza, Mukherjee, & Mace, 2011; Douglas, Lasley, & Leidy, 2015; Veldhorst, Nieuwenhuizen, Hochstenbach-Waelen, van Vught et al., 2009a), suggesting protein source may influence appetite and subsequent food intake.

Snacking is often suggested to contribute to the development of overweight and obesity (Berteus Forslund, Torgerson, Sjostrom, & Lindroos, 2005; Chapelot, 2011; Howarth, Huang, Roberts, Lin, & McCrory, 2007; Savige, Macfarlane, Ball, Worsley, & Crawford, 2007). Snack intake is positively associated with increased energy intake and obese individuals have been found to consume snacks more frequently than non overweight individuals (Berteus Forslund et al., 2005). Food choices related to snacking are also an area of concern. Food groups such as baked goods, sweets, and beverages have been linked to snacking in normal weight adults (Cross, Babicz, & Cushman, 1994; Hampl, Heaton, & Taylor, 2003; Summerbell, Moody, Shanks, Stock, & Geissler, 1995), however, there is not much data regarding types of snacks in overweight and obese individuals. One study has shown that sweet, fatty food groups are associated with snacking and contribute considerably to overall energy intake (Berteus Forslund et al., 2005). The results from these studies indicate that a reduction in snacking, particularly energy-dense snacks, could be beneficial for reducing energy intake.

Nutrition labeling on food products is a potential tool for promoting healthy eating (Cowburn & Stockley, 2005), especially at meal time. A wide range of studies have examined the association between nutrition label use and health practices, finding that individuals with healthier eating habits are more frequent users of nutrition labels (Campos, Doxey, & Hammond, 2011); and observational studies have found associations between healthier diets and use of nutrition labels (reviewed by (Campos et al., 2011). However, the direct impact of nutrition labeling on subsequent food intake under controlled conditions has not been well studied. In addition, the impact of nutritional messaging such as health on front of package on subsequent food choice has mixed results (Kerr, McCann, & Livingstone, 2015; Ni Mhurchu et al., 2017; Watson et al., 2014). Another option to relay nutrition messages is through regular messaging (Fassnacht, Ali, Silva, Goncalves, & Machado, 2015; Partridge, McGeechan, Bauman, Phongsavan, & Allman-Farinelli, 2016; Zwickert et al., 2016). Text messaging interventions have been shown to promote weight loss maintenance in obese adults (Zwickert et al., 2016), improve healthy habits such as fruit and vegetable consumption in children (Fassnacht et al., 2015), and decreased sugar-sweetened beverage consumption in young adults (Partridge et al., 2016).

Although several studies demonstrate positive effects of protein consumption at breakfast, very few have focused on the impact the source of protein has on satiety and food intake following breakfast. In addition, there is a gap in the literature regarding the impact of educational nutrition messaging at breakfast on subsequent snack intake. Therefore, the objective of this study was to determine if educational nutrition messaging and protein source influenced snack intake 2 h following the breakfast meal.

2. Materials and methods

2.1. Participants

Men and women, ages 18–40, were recruited to participate in this study. Participants were recruited via the University online newsletter, social media and word-of-mouth. Initial screening was carried out via phone interview. Participants enrolled in the study regularly consumed breakfast (≥5 times per week). Participants who were underweight (BMI ≤18.5), smoked, had dietary restrictions, were actively trying to lose weight, had lost weight in the last six months, were taking medication (excluding hormonal birth control), had food allergies, had aversion the foods served during the study, were athletes or participated in regular physical activity (>3 times per week), and/or had any pre-existing metabolic conditions (e.g. type 1 or 2 diabetes) that prevented them from consuming the food offered in the study were excluded from participating. In addition, women participating in the study were scheduled during the follicular phase of menstruation. Recruitment was performed between February 2016 and March 2016. Written consent was obtained from all participants prior to starting the study. The study protocol was approved by the Office of Research Compliance Institutional Review Board of the University of Arkansas (Fayetteville, AR, USA; #15-05-753).

2.2. Study design

Participants (n = 33) were randomly assigned to one of two groups: educational nutrition messaging (EM; n = 16) or no messaging (NM; n = 17) group. Participant characteristics can be found in Table 1. The study was conducted using a randomized, cross-over design in which each participant received each of two breakfast beverages, whey protein-based (WP) and.

pea protein-based (PP), with at least one-week between each intervention day (with no more than two weeks between intervention days). To determine samples size, a power analysis was conducted using a two-tail alpha error of 5% to give a statistical power of 88.1%. Participants in the EM group were presented with five educational nutrition messages about the health benefits dietary protein (Supplemental Table 1**)** at the time of consumption of the breakfast beverage. The messages were presented on one sheet

Table 1
Participant characteristics.

	Educational Messaging (EM)	No Messaging (NM)
Participants, *n*	16	17
Age, y	24.2 ± 1.6	22.9 ± 0.8
Height, cm	166.5 ± 1.5	169.9 ± 2.1
Weight, kg	68.9 ± 3.8	71.3 ± 3.0
BMI, kg/m^2	24.8 ± 1.3	24.8 ± 1.2
Sex		
Male	4	6
Female	12	11
Ethnicity		
African American	3	2
Asian	3	1
Caucasian	8	11
Hispanic		3
Indian	1	