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Nutritional value of foods sold in vending machines in a UK University: Formative, cross-sectional research to inform an environmental intervention

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ABSTRACT

Vending machine use has been associated with low dietary quality among children but there is limited evidence on its role in food habits of University students. We aimed to examine the nutritional value of foods sold in vending machines in a UK University and conduct formative research to investigate differences in food intake and body weight by vending machine use among 137 University students. The nutrient content of snacks and beverages available at nine campus vending machines was assessed by direct observation in May 2014. Participants (mean age 22.5 years; 54% males) subsequently completed a self-administered questionnaire to assess vending machine behaviours and food intake. Self-reported weight and height were collected. Vending machine snacks were generally high in sugar, fat and saturated fat, whereas most beverages were high in sugar. Seventy three participants (53.3%) used vending machines more than once per week and 82.2% (n 60) of vending machine users used them to snack between meals. Vending machine accessibility was positively correlated with vending machine use ($r = 0.209$, $P = 0.015$). Vending machine users, compared to non-users, reported a significantly higher weekly consumption of savoury snacks (5.2 vs. 2.8, $P = 0.014$), fruit juice (6.5 vs. 4.3, $P = 0.035$), soft drinks (5.1 vs. 1.9, $P = 0.006$), meat products (8.3 vs. 5.6, $P = 0.029$) and microwave meals (2.0 vs. 1.3, $P = 0.020$). No between-group differences were found in body weight. Most foods available from vending machines in this UK University were of low nutritional quality. In this sample of University students, vending machine users displayed several unfavourable dietary behaviours, compared to non-users. Findings can be used to inform the development of an environmental intervention that will focus on vending machines to improve dietary behaviours in University students in the UK.

1. Introduction

Overweight and obesity constitute major public health issues in the United Kingdom (UK), with approximately 25% of UK adults being obese and 37% overweight (Health and Social Care Information Centre, 2014). Commencing University studies can be a challenging period for undesirable weight gain, with University students gaining an average of 2–7lbs during their first year of studies (Hoffman, Policastro, Quick, & Lee, 2006; Levitsky, Garay, Nausbaum, Neighbors, & Dellavalle, 2006; Kasparek, Corwin, Valois, Sargent, & Morris, 2008; Racette, Deusinger, Strube, Highstein, & Deusinger, 2008; Crombie, Ilich, Dutton, Panton, & Abood, 2009), a weight gain likely to track into adulthood (Racette et al., 2008). Diets of University students are usually high in fat, sugar and salt (Soriano, Molto, & Manes, 2000; Anding, Suminski, & Boss, 2001; Chourdakis et al., 2011), which might contribute to the aforementioned weight gain (Brunt, Rhee, & Zhong, 2008; Kasparek et al., 2008; Racette et al., 2008), and also tend to be maintained in adulthood (Crombie et al., 2009). Therefore, factors influencing food habits among University students need to be identified to prevent overweight and obesity later in life.

Several studies have recently put emphasis on the potential role of vending machines in eating behaviours and dietary quality. Foods sold in vending machines in schools, hospitals and work settings have been reported to be low in fibre and high in calories, sugar and salt (French, Story, Fulkerson, & Gerlach, 2003; Shimotsu,

Abbreviations: BMI, Body mass index; EU, European Union; FFQ, Food Frequency Questionnaire; UK, United Kingdom; WHO, World Health Organisation.

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French, Gerlach, & Hannan, 2007; Lawrence, Boyle, Craypo, & Samuels, 2009; French et al., 2010; Kibblewhite, Bowker, & Jenkins, 2010; Kubik, Lytle, & Farbakhsh, 2011; Pasch et al., 2011). Vending machine behaviours, such as vending machine accessibility and use, have been positively associated with consumption of snacks (Neumark-Sztainer, French, Hannan, Story, & Fulkerson, 2005; Thompson, Yaroch, Moser, Finney Rutten, & Agurs-Collins, 2010; Minaker et al., 2011; Rovner, Nansel, Wang, & Iannotti, 2011) and soft drinks (Wiecha, Finkelstein, Troped, Fragala, & Peterson, 2006; Nickelson, Roseman, & Forthofer, 2010), although an earlier study among UK school children did not show a link between confectionery bought from vending machines and dietary quality (New & Livingstone, 2003). School vending machine availability has also been shown to affect children's lunchtime choices, with one study reporting that more children replaced lunch with vending machine snacks or beverages, when these were available (Park, Sappenfield, Huang, Sherry, & Bensyl, 2010). The availability of energy-dense, low-nutrient foods from vending machines (Fox, Dodd, Wilson, & Gleason, 2009) and the presence of beverage vending machines (Minaker et al., 2011) have also been associated with higher body mass index (BMI) among school children (Fox et al., 2009; Minaker et al., 2011).

The majority of studies examining the role of vending machine accessibility and use in dietary quality and body weight have been conducted among school children. To our knowledge, only one US study assessed the nutritional quality of vending machine foods available at campuses and reported that they were energy-dense and low in nutrients (Byrd-Bredbenner et al., 2012), whereas another study showed that vending machine use was positively associated with BMI in 160 Scottish and Greek University students, although this latter association was only evident for students choosing vending machine chocolate bars (Spanos & Hankey, 2010). Seeing from the limited evidence regarding the nutrient content of foods sold in vending machines in UK Universities and the potential role of vending machines in University students' food intake and body weight, the primary aim of the current study was to assess the nutritional value of foods sold in vending machines in a UK University. The secondary aim was to conduct a cross-sectional survey to investigate differences in food intake and body weight, according to vending machine use, among a convenience sample of 137 University students. Complying with current frameworks of developing complex interventions (Craig et al., 2008; World Health Organisation, 2009), findings from this study will form the formative research base on which to develop a future intervention that will aim to investigate the impact of changing the vending machine food environment on University students' dietary quality and body weight.

2. Materials and methods

The snack and beverages sold in vending machines at the University of Bristol campus were assessed in May 2014 (phase 1). Subsequently (phase 2, June 2014), a cross-sectional survey was conducted among a sample of University students, who volunteered to complete a questionnaire assessing vending machine behaviours, food habits and body weight. All study procedures were approved by the Centre of Exercise, Nutrition and Health Sciences Research Ethics Committee.

2.1. Availability of vending machines and nutritional value of foods sold

A University of Bristol website search identified nine campus locations where vending machines were available, out of a total of 65 University buildings (a total of 9 vending machines). These locations consisted of four libraries, one study centre, one cafeteria, the student's union building, and two other academic buildings and were all within walking distance of the majority of the 65 University buildings. A direct observation of the snacks and beverages sold by each vending machine was conducted by a single investigator (HP), in order to assess the variety of products sold by vending machines throughout the University and their nutritional value. A product was included in this report if it was available from at least one of the vending machines. Different flavours of the same product (e.g. crisps/potato chips) were considered as different products. Vending machines selling hot beverages (e.g. coffee, tea etc.) were excluded.

The following information was recorded from the vending machines: product name, brand (not currently reported) and container size. Front-of-pack nutritional information (grams per serving/container), when available, was recorded for fat, saturated fat, sugar and salt. When this information was not available on the product, it was obtained from the respective brand's website. To assess the nutritional value of available products, the products' front-of-pack nutritional information was compared to the UK front-of-pack nutrition labelling guidance (Department of Health, 2013). The cut-off values for a snack or beverage being considered to have a low, medium or high content in the above nutrients can be found in the footnote of Table 1.

2.2. Participants

The University of Bristol comprises approximately 12,500 undergraduate and 5500 postgraduate students. Taking into account the short timeframe of the study, a convenience sample of University students was recruited to complete a survey for the study's second phase. Participants were approached at the café areas of two libraries and the students' study centre by the investigator (HP), who informed them of the study's aims and provided them with an information sheet. Participants had to be current students (either undergraduate or postgraduate) at the University of Bristol. All participants provided written informed consent prior to completing the study's self-administered questionnaire. All data were collected on an individual basis, with the investigator discreetly present to resolve any queries. All participants were volunteers and the questionnaire was anonymous.

2.3. Questionnaire development

A self-administered questionnaire was used to obtain data about demographic characteristics, vending machine behaviours, consumption frequency of selected food items, general food habits and body weight and height. The questionnaire required 10–15 min to complete.

Demographic information consisted of participants' age, sex, nationality (UK, EU, international), and status of study (full-time/part-time, undergraduate/postgraduate). The section on vending machine behaviours included six questions. Participants were asked to report how many vending machines around campus they could access in their daily routine (and in which locations), how many times per week they used vending machines (‘0 days per week’/‘1–2 days per week’/‘≥3 days per week’) and the weekly frequency (same answer categories) of buying specific snacks (‘Chocolate or chocolate bars’/‘Crisps (potato chips)’/‘Candy bars’/‘Other’) and beverages (‘Soft drinks’/‘Diet soft drinks’/‘Fruit juice’/‘Water’/‘Other’) available from vending machines. Participants who reported using vending machines ‘0 days per week’ were considered as ‘non-users’, whereas all others were categorised as ‘users’. The product categories were derived based on the foods sold by vending machines around campus, as identified in phase 1 of the