



Research report

Behavioural strategies to control the amount of food selected and consumed ☆,☆☆

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ABSTRACT

Several factors within the food environment may stimulate overconsumption. The present study aimed to (1) identify behavioural strategies to cope with this environment to control the amount of food consumed, (2) examine the feasibility and usefulness of the strategies, and (3) evaluate the association between the strategies and body mass index (BMI). After the literature was screened for evidence of factors that contribute to the consumption of large amounts of food, 32 behavioural strategies were identified to overcome these influences (study 1). Subjectively reported feasibility and usefulness of the 32 behavioural strategies in weight management were explored using a pretest post-test study (study 2: $n = 52$). Additionally, two cross-sectional questionnaire studies (study 3a: $n = 120$ and study 3b: $n = 278$) were conducted to evaluate the association between the 32 behavioural strategies and BMI. The strategies were subjectively reported as feasible and useful in weight management. Frequent use of strategies discriminated non-overweight from overweight individuals, but did not discriminate overweight from obese individuals. In conclusion, the findings provided preliminary evidence for the acceptability and validity of the strategies. The effectiveness of the strategies for controlling the amount consumed should be further investigated, especially in overweight and obese participants.

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Introduction

There are numerous factors of the food environment that may stimulate overconsumption whereby food intake exceeds daily requirements, resulting in a positive energy balance (French, Story, & Jeffery, 2001; Swinburn, Egger, & Raza, 1999). Also, several environmental cues (i.e. music, in-store media such as talking shelves, food-commercials and advertisements) influence eating and food purchasing behaviours in ways that people cannot even recognize or resist (Cohen & Babey, 2012). Key factors in the food environment associated with a surplus amount of foods consumed are (1) the availability of high caloric tempting foods, (2) easy accessibility of high-caloric, low nutrient-dense foods, (3) the presence of large food portion sizes, and (4) price and marketing strategies that persuade consumers to increase their food purchases of high-caloric or low-nutrient dense products (Brownell, 2004). To empower individuals to cope with the influences of the food

environment on the amount of high caloric they consume, a solution might be found in increasing their ability to self-regulate the amount of food they select and consume (de Ridder & de Wit, 2006; Steenhuis & Vermeer, 2009).

Self-regulation refers to all efforts to steer attention, emotions and behaviours to reach beneficial long-term goals (i.e. weight loss), even when there are short-term temptations (i.e. a nice cookie) or conflicting long-term goals (De Ridder & de Wit, 2006). In the context of controlling the amount of food consumed, self-regulation refers to efforts to control and maintain adequate selection and intake of the amount of food, thereby resisting or adapting temptations and situations by which one is triggered to overeat. As a first step towards improving self-regulation of the amount of food consumed, it is important to identify and evaluate evidence-based behavioural strategies that help individuals to regulate the amount of food selected and consumed.

Therefore, the aim of this manuscript was to identify behavioural strategies to control the amount of food selected or consumed and to determine the preliminary evidence for their acceptability and validity. In study 1, existing literature on factors influencing the amount of food selected and consumed were reviewed, and behavioural strategies to eliminate or to cope with these factors were identified. In study 2, the current use of these strategies by individuals was evaluated, and furthermore, the strategies were evaluated for their feasibility, usefulness and outcome

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expectancies. In study 3, the use of the strategies was evaluated for their association with body mass index (BMI). Finally, overall conclusions and implications for further research and practice were explored.

Study 1: Identification and evidence of behavioural strategies to control food consumption amounts

Methods

Based on literature in the field of eating and consumer behaviour and marketing research found in the PubMed database, factors associated with the selection and intake of large amounts of food were identified. Literature was searched using keywords such as 'portion size', 'energy intake', 'food intake', 'food selection' and 'food consumption'. Further studies were identified based on references in the retrieved manuscripts. Studies with adults, adolescents or mixed study samples as research population were selected, and outcome measures had to be related to the amount of food selected or consumed.

Results

In total, 51 articles were included to identify factors associated with surplus food selection and intake. In short, these factors were related to purchase behaviour, meal and package size, stockpiling, food exposure (e.g. visibility of foods), mindless eating (e.g. as a consequence of being distracted by watching television) and portions in eating establishments (e.g. food portions in restaurants).

Based on these factors, 32 behavioural strategies to eliminate or to cope with the associated influences were identified. These behavioural strategies increase people's ability to self-regulate the amount of food they select and consume and might decrease individuals risk for overconsumption due to daily life influences of the current (Western) food environment. Below, each factor is discussed. Additionally, for each factor the behavioural strategies are presented. A complete overview of all strategies is presented in [Table 1](#).

Purchase behaviour

Relevant price marketing strategies used to persuade consumers to buy larger amounts and more products are value size pricing ([Wansink, 1996](#)), bundle promoting ([Foubert & Gijsbrechts, 2007](#)) and free sampling ([Heilman, Lakishyk, & Radas, 2011](#)), as consumers will select a package size that maximizes utility ([Wansink, 1996](#)). Large packages are made attractive for customers because a lower price per unit is paid. Also, because of regular sale promotions, consumers might increase their purchase volume. These marketing strategies generally lead to lower costs per unit for large food portions, which consequently leads to higher usage volume ([Wansink, 1996](#)). Moreover, high-calorie, low nutrient-dense foods are rather cheap compared to low-calorie high nutrient-dense foods ([Waterlander et al., 2010](#)).

In bundling promotions, customers get a discount when a specific (but larger) quantity is purchased (e.g. buy two, get 50 cents off). Bundle promotions with low purchase requirements stimulate purchases among customers who are used to buying products within the food category ([Foubert & Gijsbrechts, 2007](#)), even if they did not intend on buying the promoted food.

In-store free samples further persuade customers to taste and buy the sampled food. Research demonstrated that when offered, 70% of the shoppers consumed a free sample, of which 40% bought the sampled food ([Heilman et al., 2011](#)). Obese consumers were

found to be more vulnerable to increasing their in-store purchases when tasting a free sample ([Steinberg & Yalch, 1978](#)). The behavioural strategies to control the amount of food selected corresponding to purchase behaviour are:

- (1) *When grocery shopping, make a list in advance and do not deviate from it when you are in the supermarket. Do not be tempted by special deals and offers (bundle promotions such as buy-two-get-\$1-off or buy-one-get-one-free).* ([Foubert & Gijsbrechts, 2007](#); [Wansink, 1996](#))
- (2) *Don't buy jumbo-sized packages (30% extra or the largest package) and do not buy large quantities at once.* (e.g. [Wansink, 1996](#); [Raynor & Wing, 2007](#))
- (3) *Don't taste free samples at shops.* ([Heilman et al., 2011](#); [Steinberg & Yalch, 1978](#))

Meal and package sizes

People perceive serving sizes that are larger than reference serving sizes as appropriate to serve themselves ([Schwartz & Byrd-Bredbenner, 2006](#)). Larger than necessary meals promote passive overconsumption, and research demonstrated a positive association between the portion size served and the amount consumed ([Diliberti, Bordi, Conklin, Roe, & Rolls, 2004](#); [Jeffery et al., 2007](#); [Kral & Rolls, 2004](#); [Rolls, Roe, & Meengs, 2007](#); [Wansink, van Ittersum, & Painter, 2006](#)), though no association between ratings of hunger and satiety and the portion size served was found ([Rolls, Morris, & Roe, 2002](#); [Rolls, Roe, & Meengs, 2006](#)).

Also, the amount of pre-packaged food consumed is driven by the size of the single food items and by the size of the package. Individuals increase their energy intake when consuming larger food items by weight compared to small food items (e.g. candies weighing 4 g versus candies weighing 2 g), even when the total caloric content of both portions provided is similar ([Marchiori, Waroquier, & Klein, 2011](#)). Moreover, people consume more out of large packages than out of small packages ([Flood, Roe, & Rolls, 2006](#); [Rolls, Roe, Kral, Meengs, & Wall, 2004](#)) independent of the perceived taste ([Wansink & Park, 2001](#)) or food quality ([Wansink & Kim, 2005](#)). This phenomenon arises for packages of high-convenience foods (e.g. the amount of chips consumed increases as the package size increases) ([Rolls et al., 2004](#)), as well as for packages of low-convenience food that requires preparation before consumption (e.g. a portion of spaghetti that needs to be removed from the package to be cooked) ([Wansink, 1996](#)). Even the container size independently of the portion size influences the amount consumed ([Marchiori, Corneille, & Klein, 2012](#)). Another cause of selecting and consuming large portions might be the result of the 'unit bias' ([Geier, Rozin, & Doros, 2006](#)). In this case, people think that a single package is the appropriate and optimal amount to consume, yet the package actually contains more servings than appropriate for a single eating occasion. Due to unit bias, people are unaware of consuming more than appropriate. The behavioural strategies to control the amount of food selected and consumed corresponding to this factor are:

- (4) *Don't consume the total amount of a package or container of food but determine the amount of a 'normal' serving size to eat.* (e.g. [Diliberti et al., 2004](#); [Flood et al., 2006](#); [Geier et al., 2006](#); [Jeffery et al., 2007](#); [Kral & Rolls, 2004](#); [Rolls et al., 2004](#); [Schwartz & Byrd-Bredbenner, 2006](#); [Marchiori et al., 2012](#);
- (5) *When preparing a meal, decide what a normal serving size of the ingredients per person is beforehand. Don't use the whole package automatically, but take the number of people who will be eating into account.* (e.g. [Geier et al., 2006](#); [Schwartz & Byrd-Bredbenner, 2006](#)).

Table 1

Thirty-two evidence-based behavioural strategies to control the amount of food consumed and self-reported use for each strategy of the study populations involved.

No. behavioural strategy to control the amount of food consumed ^a	Mean (SD) for each behavioural strategy ^b		
	Study population of study 2, N = 52	Study population of study 3a, N = 120	Study population of study 3b, N = 278
1. When grocery shopping, make a list in advance and do not deviate from it when you are in the supermarket. Do not be tempted by special deals and offers (bundle promotions such as buy-two-get-\$1-off or buy-one-get-one-free)	3.67 (1.54)	3.69 (1.59)	3.89 (1.42)
2. Don't buy jumbo-sized packages (e.g. 30% extra or the largest package) and do not buy large quantities at once	3.13 (1.22)	3.06 (1.27)	2.98 (1.28)
3. Don't taste free samples at shops	3.77 (1.42)	4.10 (1.27)	3.58 (1.43)
4. Don't consume the total amount of a package or container of food but determine the amount of a 'normal' serving size to eat	4.06 (1.32)	4.07 (1.31)	3.55 (1.38)
5. When preparing a meal, decide what a normal serving size of the ingredients per person is beforehand. Don't use the whole package automatically, but take the number of people who will be eating into account	3.52 (1.54)	3.36 (1.60)	3.07 (1.53)
6. Just serve yourself once/only have one serving	3.75 (1.24)	3.64 (1.50)	3.77 (1.27)
7. Decide on the amount of food you will serve and limit the total amount	3.27 (1.30)	3.39 (1.43)	3.10 (1.24)
8. Eliminate the frequent purchase of tempting foods (sweets and/or snacks), but buy such foods occasionally	2.38 (1.51)	2.38 (1.33)	2.17 (1.24)
9. Don't buy tempting foods (sweets and/or snacks) for events in the future or unexpected occasions (e.g. visitors) that you will be tempted to eat	3.31 (1.28)	3.33 (1.32)	3.40 (1.24)
10. Store tempting foods (such as sweets and candies) well packaged, out of sight and out of reach	4.58 (0.85)	4.46 (0.97)	4.28 (1.16)
11. Don't store (tempting) foods in several places such as in the glove compartment of the car or the desk drawer at work. Keep these places snack-free!	4.48 (1.00)	4.48 (0.92)	4.35 (1.14)
12. Don't eat or put food in your mouth because it is 'just there' or because you passed by	3.60 (1.18)	3.81 (1.19)	3.32 (1.20)
13. Don't eat directly from the refrigerator or pantry	4.15 (1.11)	4.25 (1.08)	3.60 (1.33)
14. When preparing a meal, don't snack on the ingredients	3.60 (1.43)	3.53 (1.53)	3.11 (1.49)
15. When making a sandwich, don't snack on the ingredients	3.98 (1.24)	4.30 (1.18)	3.75 (1.36)
16. When getting a soda or juice, don't drink out of the glass when you pour a glass	4.10 (1.16)	4.43 (1.05)	4.12 (1.25)
17. When eating palatable and tempting foods, determine a normal serving in advance and store the rest of the package out of sight and reach	3.33 (1.43)	3.33 (1.54)	2.94 (1.25)
18. When at a party put yourself out of reach of tempting foods	3.73 (0.93)	3.86 (1.12)	3.73 (1.06)
19. Don't keep the leftovers of the appetizer (e.g. bread, and snacks) on the table during the main course but clear away these foods	4.64 (0.94)	4.66 (0.79)	4.65 (0.89)
20. Do not keep the leftovers of the main dish on the table after you've finished eating	3.90 (1.47)	3.97 (1.38)	4.03 (1.42)
21. When having dinner, serve yourself in the kitchen and avoid dishes, sauces or bottled drinks at the dining table. Only put healthy foods such as salads, vegetables or a carafe of water on the dining table	2.67 (1.72)	2.69 (1.67)	2.78 (1.74)
22. Make it a habit to leave something on your plate when you stop eating	1.67 (1.13)	1.86 (1.22)	1.87 (1.18)
23. Control your food consumption by limiting your daily intake to the main meals and restricting the moments you will eat in between to a maximum of three times a day	3.48 (1.41)	4.08 (1.29)	3.05 (1.45)
24. Avoid other activities such as watching television, reading or driving a car when eating	3.00 (1.51)	3.21 (1.42)	2.54 (1.36)
25. Avoid eating during work-related activities such as meetings, working at your desk or making telephone calls	4.42 (1.00)	4.05 (1.30)	3.78 (1.47)
26. Take your time when eating your meal	3.42 (1.02)	3.38 (1.25)	2.87 (1.15)
27. Notice when you are satisfied and if so, stop eating	3.67 (1.14)	3.96 (1.12)	2.65 (1.22)
28. Stop eating when you have had enough/are satisfied, even if you have not cleared your plate	3.14 (1.46)	3.41 (1.52)	2.94 (1.38)
29. When eating out or ordering takeaway food, decide in advance the serving size to eat. Often the portions of these foods are too much for one person	2.46 (1.36)	2.18 (1.50)	1.76 (1.15)
30. When eating out, only order a maximum of two dishes or share one or more dishes with someone else	2.67 (1.54)	3.13 (1.62)	2.90 (1.56)
31. When there is a choice of portion size, pick the smallest one	2.62 (1.32)	2.79 (1.36)	2.55 (1.22)
32. When going to a buffet, serve yourself small amounts of the dishes. Take into account that the total amount you are taking should fit on one plate	2.37 (1.44)	2.69 (1.44)	2.24 (1.24)

^a The number of the behavioural strategy refers to the number presented in the manuscript in study 1.^b Mean (SD) on a five-point Likert scale.

- (6) *Just serve yourself once/only have one serving.* (e.g. Jeffery et al., 2007; Kral & Rolls, 2004; Marchiori et al., 2011; Marchiori et al., 2012; Rolls et al., 2007).
- (7) *Decide on the amount of food you will serve and limit the total amount.* (Diliberti et al., 2004; Geier et al., 2006; Jeffery et al., 2007; Rolls et al., 2002; Wansink, Painter & Lee 2006).

Stockpiling

The quantity and manner of in-home stockpiling influence the amount consumed, especially for high-convenience foods (Chandon & Wansink, 2002; Raynor & Wing, 2007). High-convenience foods require little effort prior to consumption (e.g. snacks). The incidence of consumption of these foods increases when the stockpiled foods are more visible (Chandon & Wansink, 2002; Ferriday & Brunstrom, 2008; Wansink et al., 2006). For both high- and low-convenience foods, large amounts of stockpiled foods also induce increased usage, the intake of larger amounts (Chandon & Wansink, 2002) and thus greater energy intake (Raynor & Wing, 2007).

The behavioural strategies to control the amount of food selected corresponding to this factor are:

- (8) *Eliminate the frequent purchase of tempting foods (sweets and/or snacks), but buy such foods occasionally.* (Chandon & Wansink, 2002; Raynor & Wing, 2007)
- (9) *Don't buy tempting foods (sweets and/or snacks) for events in the future or unexpected occasions (e.g. visitors) that you will be tempted to eat.* (Chandon & Wansink, 2002; Raynor & Wing, 2007)
- (10) *Store tempting foods (such as sweets and candies) well packaged, out of sight and out of reach.* (e.g. Chandon & Wansink, 2002; Ferriday & Brunstrom, 2008; Wansink et al., 2006)
- (11) *Don't store (tempting) foods in several places such as in the glove compartment of the car or the desk drawer at work. Keep these places snack-free!* (Chandon & Wansink, 2002; Ferriday & Brunstrom, 2008; Wansink et al., 2006)

Food exposure and unplanned eating

It has been estimated that people make 200 eating decisions a day (Wansink & Sobal, 2007), although most often, food intake is not initiated by internal cues, such as hunger, but by external cues (e.g. mealtimes, contextual food cues) (Cohen & Babey, 2012; Tuomisto, Tuomisto, Hetherington, & Lappalainen, 1998). An important factor that contributes to this large number of food decisions is the exposure to foods. Examples of in-home food exposure are the availability of a sweet bowl in the living room, and snacks visible on the counter and in the refrigerator.

Studies showed that food exposure evokes individuals' desire to eat, prompts their desire to consume larger amounts, and also increases the actual amount they consume (Fedoroff, Polivy, & Herman, 1997; Ferriday & Brunstrom, 2008; Marcelino, Adam, Couronne, Koster, & Sieffermann, 2001). Several reasons might account for this larger intake. When exposed to easily accessible foods (e.g. snacks within reach), individuals perceive that obtaining these foods requires less effort to consume (Wansink et al., 2006). Moreover, easily accessible foods are perceived as more difficult to resist and are more attention-grabbing (Engell, Kramer, Malafi, Salomon, & Leshner, 1996; Maas, de Ridder, de Vet, & de Wit, 2012; Wansink et al., 2006). The availability of foods might induce unplanned eating meaning the consumption of food that was not intended and is most often unrecognized (e.g. someone having a few bites of a snack when passing through the kitchen, eating a slice of cheese when preparing a sandwich). During meals, individuals also experience difficulties in monitoring their intake when exposed to a large portion, consequently leading to larger amounts

of food consumed. A key reason is that individuals rely on visual food cues such as how much there is left on their plate (Wansink, Painter, & North, 2005). Moreover, exposure to a variety of foods is associated with the amount consumed; serving several dishes instead of a pre-served plate during dinner is also associated with consumption of larger amounts (Nijs et al., 2006). The behavioural strategies to control the amount of food selected and consumed corresponding to this factor are:

- (12) *Don't eat or put food in your mouth because it is 'just there' or because you passed by* (e.g. Cohen & Babey, 2012; Tuomisto et al., 1998)
- (13) *Don't eat directly from the refrigerator or pantry.* (e.g. Wansink & Sobal, 2007; Wansink et al., 2006)
- (14) *When preparing a meal, don't snack on the ingredients.* (e.g. Wansink & Sobal, 2007; Wansink et al., 2006)
- (15) *When making a sandwich, don't snack on the ingredients.* (e.g. Wansink & Sobal, 2007; Wansink et al., 2006)
- (16) *When getting a soda or juice, don't drink out of the glass when you pour a glass.* (e.g. Wansink & Sobal, 2007)
- (17) *When eating palatable and tempting foods, determine a normal serving in advance and store the rest of the package out of sight and reach.* (e.g. Fedoroff et al., 1997; Ferriday & Brunstrom, 2008; Marcelino et al., 2001)
- (18) *When at a party put yourself out of reach of tempting foods.* (Engell et al., 1996; Maas et al., 2012; Wansink et al., 2006)
- (19) *Don't keep the leftovers of the appetizer (e.g. bread, snacks) on the table during the main course but clear away these foods.* (Engell et al., 1996; Nijs et al., 2006)
- (20) *Do not keep the leftovers of the main dish on the table after you've finished eating.* (Engell et al., 1996; Nijs et al., 2006)
- (21) *When having dinner, serve yourself in the kitchen and avoid dishes, sauces or bottled drinks at the dining table. Only put healthy foods such as salads, vegetables or a carafe of water on the dining table.* (Engell et al., 1996)
- (22) *Make it a habit to leave something on your plate when you stop eating.* (e.g. Tuomisto et al., 1998; Wansink et al., 2005)

Mindless eating

Individuals engaged in mindless eating are eating while distracted and not focused on the food they are consuming. Mindless eating impairs individuals ability to accurately estimate the amount of food they consume (Moray, Fu, Brill, & Mayoral, 2007) and they are hindered from making deliberate decisions on how much they should eat. When eating mindlessly, individuals report lower degrees of fullness and a greater desire to eat compared to those that are not distracted (Brunstrom & Mitchell, 2006). Consequently, individuals are at risk of consuming surplus amounts when enough food is available (Stroebele & De Castro, 2004). Watching television, playing a computer game, listening to the radio and dining with others are factors that typically lead to mindlessly eating larger amounts than intended (Bellisle, Dalix, & Slama, 2004; Boulos, Kuross, Oppenheimer, Chang, & Kanarek, 2012; de Castro & Brewer, 1992; Oldham-Cooper, Hardman, Nicoll, Rogers, & Brunstrom, 2011). Mindless eating might also reduce individuals' sensory-specific satiety, meaning that perceived pleasantness from the food declines less rapidly and therefore postpones meal termination. When eating mindlessly, people have difficulty remembering the food consumed recently. These consequences of mindless eating result in an increase in the quantity consumed (Bellisle et al., 2004; Blass et al., 2006; Hetherington, Anderson, Norton, & Newson, 2006) and also in the amount of food consumed later that day (Higgs & Woodward, 2009; Mittal, Stevenson, Oaten, & Miller, 2011; Oldham-Cooper et al., 2011). Further, the speed by which a meal is consumed influences the amount

consumed: eating slowly leads to a decrease in the quantity consumed (Andrade, Greene, & Melanson, 2008) and induces earlier satiety because of higher concentrations of saturation hormones (Kokkinos et al., 2010). The behavioural strategies to control the amount of food consumed corresponding to this factor are:

- (23) *Control your food consumption by limiting your daily intake to the main meals and restricting the moments you will eat in between to a maximum of three times a day.* (e.g. Tuomisto et al., 1998; Wansink & Sobal, 2007)
- (24) *Avoid other activities such as watching television, reading or driving a car when eating.* (e.g. Bellisle et al., 2004; Blass et al., 2006; Boulos et al., 2012; Brunstrom & Mitchell, 2006; Hetherington et al., 2006; Higgs & Woodward, 2009; Mittal et al., 2011; Moray et al., 2007; Oldham-Cooper et al., 2011).
- (25) *Avoid eating during work-related activities such as meetings, working at your desk or making telephone calls.* (e.g. Bellisle et al., 2004; Blass et al., 2006; Brunstrom & Mitchell, 2006; Hetherington et al., 2006; Higgs & Woodward, 2009; Mittal et al., 2011; Moray et al., 2007; Oldham-Cooper et al., 2011).
- (26) *Take your time when eating your meal.* (Andrade et al., 2008; Kokkinos et al., 2010)
- (27) *Notice when you are satisfied and if so, stop eating.* (e.g. Tuomisto et al., 1998; Wansink & Sobal, 2007)
- (28) *Stop eating when you have had enough/are satisfied, even if you have not cleared your plate.* (e.g. Tuomisto et al., 1998; Wansink et al., 2005)

Dining out, all-you-can-eat and takeaway food

Since the 1970s, portion sizes of food from takeaway establishments, fast-food outlets and restaurants have increased significantly and exceed standards for dietary guidance (Young & Nestle, 2002). Most restaurant chefs are not aware that the portions they serve exceed recommended amounts (Condrasky, Ledikwe, Flood, & Rolls, 2007). In addition to an increase in the portion sizes, larger portions are added to the so-called portion size portfolio (Steenhuis, Leeuwis, & Vermeer, 2009; Young & Nestle, 2002). The larger the portion sizes available, the larger the amount of food selected and consumed. This might be caused by people's so-called 'preference for the middle'. When adding larger sizes to, or dropping smaller portions of the portion size portfolio, consumers will shift up their choice to select a portion size more in the middle (Sharpe, Staelin, & Huber, 2008).

Often, buffet-style restaurants offer an 'all-you-can-eat' system where visitors are responsible for the amount they serve themselves. Both the food variety and the fixed-pricing strategy affect people's selection and the amount consumed (Just & Wansink, 2008; Rolls et al., 1981). Because of the great variety of food, people might experience the more hedonic properties of the foods offered and be prompted to serve themselves with surplus amounts (Rolls et al., 1981).

Also, the money paid for the food consumed in 'all-you-can-eat' restaurants influences the amount people consume. Since most buffet-style restaurants have fixed-price offers, most visitors are motivated by the desire to get their money's worth and consume as much as possible. Consequently, the more people pay for their all-you-can-eat deal, the more they consume (Just & Wansink, 2008). The behavioural strategies to control the amount of food selected and consumed corresponding to this factor are:

- (29) When eating out or ordering takeaway food, decide in advance the serving size to eat. Often the portions of these foods are too much for one person. (Condrasky et al., 2007; Diliberti et al., 2004; Young & Nestle, 2002)

- (30) When eating out, only order a maximum of two dishes or share one or more dishes with someone else. (Condrasky et al., 2007; Diliberti et al., 2004; Young & Nestle, 2002)
- (31) When there is a choice of portion size, pick the smallest one. (e.g. Sharpe et al., 2008; Steenhuis et al., 2009; Young & Nestle, 2002)
- (32) When going to a buffet, serve yourself small amounts of the dishes. Take into account that the total amount you are taking should fit on one plate. (e.g. Just & Wansink, 2008; Rolls et al., 1981)

Conclusion

Study 1 provided an overview of factors related to the selection and consumption of large amounts of food and presented 32 strategies that might be helpful to eliminate these factors associated with overconsumption. Prior to the examination of the effectiveness of these behavioural strategies, insight into people's current use and their evaluation is helpful to get a concept of the feasibility and potential effectiveness.

Study 2: Exploratory study of the behavioural strategies to control the amount of food selected and consumed

After the identification of the behavioural strategies (study 1, Table 1), a formative evaluation was conducted. The central research questions were: (1) to what extent are the strategies already used by the target group population in their daily life? (2) are the behavioural strategies evaluated as feasible and useful?, and (3) what are the target group expectancies of the strategies related to maintaining weight, losing weight and improving eating habits? These insights are of importance to determine the feasibility of promoting such strategies in health educational interventions aimed at reducing energy intake.

Methods

Study design, participants and procedures

A pilot intervention study using a one-group pretest post-test design was conducted. Two-hundred-forty-four adults, who had participated in an unrelated previous study and had expressed interest in participating in further research, were invited by e-mail (Vermeer, Steenhuis, Leeuwis, Heymans, & Seidell, 2011). Those who signed up for participation were sent the pretest questionnaire immediately by mail ($n = 70$, 28.7%). After returning the pretest questionnaire ($n = 63$, 90%), participants received written intervention materials. The intervention aimed to make people aware of several situations in which they were vulnerable to select or consume large amounts of foods. Additionally, the 32 behavioural strategies were introduced. Furthermore, several assignments in the written material encouraged the participants to review all strategies and to determine which strategies could be useful and feasible to decrease their energy intake. Moreover, participants were stimulated to select three strategies that they deemed most useful and feasible and to implement these three strategies in the upcoming two weeks.

Two weeks after receiving the intervention materials participants received the post-test questionnaire. Participants that completed both pre and post-test were included in the analysis. All participants received a monetary reward of €10 for their participation. All procedures were approved by the Medical Ethical Committee of the VU Medical Center Amsterdam.

Measures

The pretest questionnaire assessed the frequency with which participants used the 32 behavioural strategies. In this

questionnaire participants were only asked how often they used these behaviours in daily life. We did not mention how the use of such behaviours can facilitate weight management. All the strategies described in Table 1 were transformed from the imperative form to the first-person form. For example, the strategy “*When preparing a meal, don't snack on the ingredients*” corresponded to the item “*When preparing a meal, I snack on the ingredients.*” The scale was developed by the research team and expert validity was established by four researchers in the field of obesity prevention who verified whether the items of the scale reflected the content of the strategies as described in Table 1 correctly and completely. Also, the readability and comprehensibility of the items were verified by five participants from the target group. In total, the scale consists of 32 items asking about the frequency with which the behavioural strategies were used on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always). Negative items were reversed, indicating that the higher the participant's score, the better participant controlled the amount of food consumed. The internal consistency for the overall scale was satisfying (Cronbach's alpha = 0.82). Items were used individually in the analyses, but also a mean score of the 32 items was computed to reflect general use of the behavioural strategies.

The post-test questionnaire determined the feasibility and individuals' outcome expectancies of the strategies regarding maintaining weight, losing weight and improving eating habits and the usefulness of the strategies to control energy intake. Feasibility of the behavioural strategies was evaluated with one item, “*The behavioural strategies are feasible in practice to limit food intake,*” on a five-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree), indicating that the higher the score, the higher the feasibility indicated.

Outcome expectancies of the behavioural strategies regarding maintaining weight, losing weight or improving eating habits were examined by three items – “*By using the behavioural strategies, I will... 1. Maintain my weight 2. Lose weight 3. Improve my eating habits*” – on a five-point Likert scale ranging from 1 (certainly not) to 5 (certainly). The items were evaluated individually, indicating that the higher the score, the greater the outcome expectancy.

For the usefulness of each behavioural strategy, participants were asked to indicate separately the usefulness of each strategy for decreasing food intake, ranging from 1 (not at all useful) to 5 (very useful). In doing so, the strategies that were indicated as the most and least useful could be determined.

Statistical analysis

General behavioural strategy use (using the composite measure of the 32 strategies) and individual strategy use were described at pretest. Furthermore, the three most and least used strategies were explored. The frequency of often-used behavioural strategies was utilized by calculating the percentage of strategies for which participants scored a 4 or 5 on a five-point Likert scale.

A multiple linear regression analysis was conducted with the participant characteristics (i.e. age, gender, and BMI) as independent variables and the mean use of the behavioural strategies as dependent variable. Educational level was not included in the analysis as only 3.8% ($n = 2$) had a low educational level.

The feasibility, outcome expectancies and usefulness of the behavioural strategies were explored using descriptive statistics. Differences in outcome expectancies were explored by using paired sample-tests. Strategies which participants found to be most and least useful were explored by calculating the mean for each strategy to determine the three strategies with the highest and the three strategies with the lowest mean score. All analyses were performed IBM SPSS Statistics 20.0 (IBM, Chicago, IL).

Results

Participants

Of the participants that completed both the pretest and the post-test ($N = 52$), 80.8% were female. The mean age was 42 years ($SD = 10.7$). 63.5% had a high educational level, and 3.8% a lower educational level. Mean BMI was 24.4 kg/m² ($SD = 3.23$, range 19.25–36.30). Furthermore, 67.3% ($n = 35$) were non-overweight, 23.1% ($n = 12$) overweight and 9.6% ($n = 5$) obese.

(1) Are behavioural strategies already used?

At pretest, the mean score for the overall use of the behavioural strategies was 3.45 ($SD = 0.51$) on a five-point Likert scale. The behavioural strategy “*Don't keep the leftovers of the appetizer (e.g. bread, snacks) on the table during the main course but clear away these foods*” had the highest mean score ($M = 4.64$, $SD = 0.85$), whereas the behavioural strategy “*Make it a habit to leave something on your plate when you stop eating*” had the lowest mean score ($M = 1.67$, $SD = 1.13$, Table 1). Participants indicated to use 54.8% of the behavioural strategies often or very often. Multiple regression analysis showed that age ($B = 0.02$, $SE = 0.01$, $P = 0.005$) was positively associated with using behavioural strategies. No associations for gender or BMI were found.

(2) Are the behavioural strategies evaluated as feasible and useful, and what are the target group expectancies of the strategies related to maintaining weight, losing weight and improving eating habits?

Participants considered the behavioural strategies generally feasible ($M = 4.16$, $SD = 0.76$). Outcome expectancies for the strategies for maintaining weight ($M = 3.94$, $SD = 0.95$), losing weight ($M = 3.47$, $SD = 1.0$) and improving eating habits ($M = 3.65$, $SD = 0.91$) were somewhat lower. Outcome expectancies for using the strategies for maintaining weight were statistically significantly higher than the expectancies for losing weight (mean difference -0.47 $t = 3.10$, $P = 0.003$).

Overall, the behavioural strategies were considered to be useful ($M = 4.02$, $SD = 0.58$, range 2.53–5.00). The strategies indicated as most useful to limit food intake were “*Take your time when eating your meal*” ($M = 4.52$, $SD = 0.73$), “*Store tempting foods well packaged, out of sight and out of reach*” ($M = 4.42$, $SD = 0.94$) and “*Eliminate the frequent purchase of tempting foods (sweets and/or snacks) but buy such foods occasionally*” ($M = 4.42$, $SD = 0.78$). The strategies indicated as least useful were “*Don't buy jumbo-sized packages and do not buy large quantities at once*” ($M = 3.27$, $SD = 1.33$), “*When eating out or ordering takeaway food, decide in advance the serving size to eat*” ($M = 3.38$, $SD = 1.12$) and “*Make it a habit to leave something on your plate when you stop eating*” ($M = 2.79$, $SD = 1.39$).

Conclusion

The results of study 2 suggest that an increased usage of behavioural strategies was associated with age. This outcome supports the notion that older persons are more inclined to use behavioural strategies compared to younger adults. However, the results must be interpreted with caution since a small sample size of only 52 participants were included in this analysis. Increasing the study sample size to investigate reasons why individuals use behaviour strategies would provide interesting further research. Moreover the results showed that the behavioural strategies were indicated as feasible in practice and useful for controlling energy intake, even though a number of strategies were used already or were indicated as less useful. These outcomes indicate that these strategies might

be well received by individuals when used for health education purposes. Prior to implementing an intervention incorporating these behavioural strategies, it is of interest to gain insight into the current use of such strategies among individuals and the relation with weight status. Identifying a relationship between the behavioural strategies and body weight would present first indications of their validity and efficacy. Study 3 of this manuscript provides data and results on this research question.

Study 3: Behavioural strategies to control the amount of food selected and consumed and the association with BMI

Behavioural strategies were defined in order to facilitate the self-regulation of food intake. It is hypothesized that these strategies are helpful for regulating energy intake. In this study, we aimed to test the association between individuals' use of behavioural strategies to control the amount consumed and their BMI.

Methods

Study design, participants and procedures

Two cross-sectional surveys (study 3a and 3b) that were both part of larger studies were used to determine the association between the use of behavioural strategies and BMI.

Study 3a was a cross-sectional survey among Dutch adults about obesity stigmatization (unpublished study) and included participants regardless of their weight status.

A random sample of 500 addresses of Dutch individuals was obtained via Cendris (www.cendris.nl), a company having access to consumer databases. Individuals of whom the addresses were obtained received the questionnaire by post. The questionnaire of this study consisted of 66 questions, but for the present analysis only the 32 items on the behavioural strategies and the four items on participant characteristics were used. Of the 500 approached participants, 120 responded.

Study 3b was a cross-sectional survey among 278 participants and formed the baseline questionnaire for a randomized controlled trial evaluating the effectiveness of a behaviour change intervention concerning food portion sizes. In this study, only participants with a BMI larger than 25 kg/m² were allowed to participate.

The baseline questionnaire consisted of 80 questions, but for the present study only 32 items on the behavioural strategies to control the amount consumed and the additional items on participant characteristics were used. The participants were recruited from the six municipalities in the Netherlands by information letters that were provided by general practitioners or through advertisements in the local media. All procedures were approved by the Medical Ethical Committee of the VU Medical Center Amsterdam.

Measures

In both populations, gender, educational level and age were determined. In the first study, self-reported weight and height were used. In the second study, objective weight and height measures were collected by research assistants. Height and weight were converted into BMI (kg/m²).

Both study populations completed the 32-item scale measuring participants' use of the behavioural strategies. In study 2 of this manuscript, the scale is described in more detail. The mean score on the 32-item scale was computed to reflect general use of the behavioural strategies. The frequency with which the often-used behavioural strategies were utilized was determined by calculating the percentage for which participants scored a 4 or 5 on a five-point Likert scale.

Statistical analysis

For both studies, all statistical analyses were conducted separately. First, baseline characteristics and the use of the behavioural strategies among participants categorized in one of the three weight categories non-overweight (BMI < 25 kg/m²), overweight (BMI 25 < 30 kg/m²) and obese (BMI ≥ 30 kg/m²) were obtained using descriptive statistics. To determine the association between BMI and the use of the behavioural strategies, a multiple linear regression analysis was conducted with BMI as the independent variable and use of the behavioural strategies as the dependent variable. Both crude and adjusted models including gender, age and educational level were run.

Results

Study population 3a

The participants had a mean age of 46.9 (SD = 12.5) years and 53% were male. A total of 49.6% had a high educational level and 12.2% had a low educational level. The mean BMI was 25.4 (SD = 4.3, range = 17.37–43.55) and 1.7% was underweight, 39% overweight and 11% obese. The majority of the participants (48.3%) had a healthy weight. The mean score for the use of the behavioural strategies was 3.54 (SD = 0.56). The behavioural strategy "Don't keep the leftovers of the appetizer (e.g. bread, snacks) on the table during the main course, but clear away these foods" had the highest mean score ($M = 4.66$, $SD = 0.79$), whereas the behavioural strategy "Make it a habit to leave something on your plate when you stop eating" had the lowest mean score ($M = 1.86$, $SD = 1.22$, Table 1).

Table 2 provides descriptive information on the use of the behavioural strategies for non-overweight and overweight participants, separately. Regression analysis showed that before and after correction for age, sex and educational level, there was a significant, negative association between BMI and overall use of the behavioural strategies (Table 3). In addition to BMI, age ($B = 0.016$, $SE = 0.004$, $\beta = 0.39$, $P = 0.01$), gender (female: $B = 0.22$, $SE = 0.09$, $\beta = 0.21$, $P = 0.01$), and educational level (middle level: $B = -0.29$, $SE = 0.14$, $\beta = -0.27$, $P = 0.38$; high level: $B = -0.47$, $SE = 0.14$, $\beta = -0.44$, $P = 0.001$) were associated either positively or negatively with the use of the strategies. These results indicated that participants with a lower BMI, females, older participants, and lower educated used more behavioural strategies.

Study population 3b

The participants had a mean age of 46.0 (SD = 10.4) years and 15.5% were male. A total of 42.7% had a high educational level and 20.9% had a low educational level. A total of 34.9% of the participants were overweight and 65.1% obese. The mean BMI was 32.4 (SD = 4.8, range = 25.12–53.26).

Table 2

Descriptives of self reported use of the behavioural strategies to control the amount of food selected or consumed for non-overweight, overweight and obese participants.

	Mean score (SD) ^b	Percentage of strategies used often (SD) ^c
<i>Study population 3a</i>		
BMI < 25 ^a	3.6 (0.5)	59.1% (15.4)
BMI ≥ 25	3.5 (0.6)	54.7% (17.8)
<i>Study population 3b</i>		
BMI 25 ≤ 30 ^a	3.3 (0.5)	47.6% (14.8)
BMI ≥ 30	3.1 (0.5)	44.9% (15.4)

^a Body weight classified by BMI (kg/m²). BMI < 25 = non-overweight, BMI 25 ≤ 30 = overweight and BMI ≥ 30 = obese.

^b Mean score of the behavioural strategy to control the amount of food selected or consumed on a five-point Likert scale.

^c Percentage of the number of behavioural strategies that were indicated as often used, defined by a score of 4 or 5 on a five-point Likert scale.

Table 3
Regression analysis with body mass index (BMI) as independent variable and three indicators use of the behavioural strategies to control the amount of food consumed as dependent variables, controlled for gender, age and educational level.

		Study population 3a ^a					Study population 3b ^a				
		B	SE	beta	t	P	B	SE	beta	t	P
Crude	Mean used strategies ^b	−0.03	0.01	−0.21	−2.30	0.02	−0.002	0.006	−0.23	−0.37	0.72
Adjusted	Mean used strategies	−0.04	0.10	−0.33	−3.97	<0.00	−0.001	0.06	−0.01	−0.22	0.83

^a In study population 3a, individuals of every with a BMI ranged from 17.37 to 43.55 were involved. In study population 3b, individuals with a BMI above 25 kg/m² (range: 25.12–53.26) participated.

^b Mean score of the behavioural strategies to control the amount consumed on a five point likert scale.

The mean score for the use of the behavioural strategies was 3.22 (SD = 0.48). The behavioural strategy “*Don’t keep the leftovers of the appetizer (e.g. bread, snacks) on the table during the main course but clear away these foods*” had the highest mean score ($M = 4.65$, $SD = 0.89$), whereas the strategy “*When eating out or ordering takeaway food, decide in advance the serving size to eat*” had the lowest mean score ($M = 1.76$ $SD = 1.15$, [Table 1](#)).

[Table 2](#) provides insight in the mean scores and often used strategies for overweight and obese participants. Regression analysis showed that after correction for age, sex and educational level, BMI was not significantly related to the use of the behavioural strategies ([Table 3](#)). Comparable to the results of study population 3a, gender (female) ($B = 0.21$, $SE = 0.08$, $\beta = 0.16$, $P = 0.01$) and age ($B = 0.009$, $SE = 0.003$, $\beta = 0.18$, $P = 0.006$) were positively related to the use of the strategies. Associations for educational level were not found.

Conclusion

The outcomes of part 3 of this manuscript indicated that the use of strategies discriminated non-overweight from overweight individuals, but did not discriminate overweight from obese individuals, suggesting first evidence of their efficacy in weight management.

General discussion

Building on previous literature on determinants of the amount of food selected and consumed, 32 evidence-based behavioural strategies were identified. The strategies aimed to control the amount of food selected and consumed in several situations, thereby reducing the risk of overconsumption. The main results revealed that the strategies were indicated as feasible and useful in weight management. The results showed that the use of strategies discriminated non-overweight from overweight and obese individuals suggesting the first evidence of their validity. This study contributes to the literature by providing behavioural strategies to control the amount of food selected or consumed. Moreover, the behavioural strategies are focused on how to cope with high-caloric and palatable foods in the environment rather than prohibiting the consumption of certain foods.

The strategies to control the amount of food consumed can be reflected as small nutrition behaviour changes. Compared to unhealthy or rigorous and extreme weight loss behaviours (e.g. laxatives, and crash diets), small changes in eating behaviour are deemed more realistic practices to reduce energy intake (e.g. intake of lean foods, and behavioural strategies). Such small changes may be more easily maintained and may gradually lead to healthier lifestyles at the individual level and eventually to reductions in obesity rates at the population-based level ([Herman & Polivy, 2003](#); [Hill, 2009](#)). Some studies have already indicated the potential of small nutrition behaviour changes at the individual level. [Lally, Chipperfield, and Wardle \(2008\)](#) indicated that simple instructions on weight control were effective in reducing weight

after a two-month period ([Lally et al., 2008](#)). [Wansink \(2010\)](#) suggested that implementing three small nutrition behaviour changes was effective in reducing weight after a three-month period ([Wansink, 2010](#)). In addition to these outcomes, it is of interest to determine whether the behavioural strategies, embedded in a more comprehensive intervention, would result in similar findings.

Consistent with earlier studies ([Drewnowski, Ahlstrom-Henderson, Driscoll, & Rolls, 1997](#); [Howarth, Huang, Roberts, Lin, & McCrory, 2007](#); [Neumark-Sztainer, Sherwood, French, & Jeffery, 2007](#)) older individuals and females reported to use different or more behavioural strategies compared to younger individuals and males. Unexpectedly, low educational level was associated with a higher use of the behavioural strategies in study 3a, but educational level was not associated with strategy use in study 3b. The results are contradictory compared to other studies, showing that a higher socio-economic status was positively associated with engaging in weight control behaviours ([Siu, Giskes, & Turrell, 2011](#); [Wardle & Griffith, 2001](#)). However, while in these studies typical weight control behaviours were determined, in our study the use of the strategies were established without emphasizing their potential usefulness to lose weight or avoid gaining weight. Future research should provide more insight into the relation between education and the use of the behavioural strategies.

The study showed some important findings that need to be taken into account in future research. For example, strategies indicated as being less useful need to be revised or introduced more comprehensively before being presented to the individuals concerned. As the strategy “*Make it a habit to leave something on your plate when you stop eating*” was scored as less useful (2.79) and was only used often by 7.7% of the participants, it can be questioned whether such a recommendation is culturally acceptable. If most individuals finish their plates anyway, strategies related to limiting the amount served make more sense. Furthermore, to leave something on your plate might send out the culturally unacceptable message that it is appropriate to waste food ([Fay et al., 2011](#)). In addition, for the strategy that suggests eliminating the purchase of promotional food packages, more detailed information might be provided on how such tempting marketing strategies increase the amount individuals purchase and consume. However, it could also be suggested that food policies or regulations might be more effective to eliminate the effect of marketing on the amount of food consumed.

A major strength of the study was that a substantial number of studies were used in the identification of evidence of the behavioural strategies. Nevertheless, we are aware of the limitations of the diversity of studies we presented. First, not every study used was of a similar quality, as some strategies were based on the outcomes of a randomized controlled trial measuring actual energy intake, while other strategies were based on observational sales data. Furthermore, some strategies were based on more than one study whereas others were based on just one. Moreover, we are aware that some strategies might be redundant while using another. For example, when you eliminate the purchase of tempting snacks, the strategies pertaining to the storage of tempting foods become irrelevant. Additionally, some strategies are more generalised

suggestions to limit the amount of food selected and consumed (e.g. control your daily amount by limiting your intake to the main meals and restricting the amount you eat in between), whereas other strategies are more practical ones (do not snack on ingredients). Likewise, it might be suggested that not all factors related to the intake of surplus amounts of foods can be translated into strategies to stimulate controlling the amount of food consumed. For example, it was found in previous studies that the amount of food consumed is larger when dining with others than when eating alone (de Castro & Brewer, 1992; de Castro, Brewer, Elmore, & Orozco, 1990). However, since dining is a social event, it is not culturally acceptable to promote meal consumption without others as a strategy to control energy intake.

An additional strength of the study was that three study populations were used to answer the research questions. Nevertheless, because of selection bias, it might be possible that the participants were already interested in food and weight management. Also, the self-reported nature of the data needs to be considered. An important source of bias might have appeared since, in two of the three data sets, self-reported weight and height were used to classify BMI. Furthermore, a limitation in the third study is that no longitudinal data were used to determine the association between BMI and the strategies to control the amount of food consumed.

In conclusion, the 32 evidence-based strategies to control the amount of food consumed are perceived as feasible in daily life and useful in weight management by individuals. The study suggests preliminary evidence for their validity. Future research should examine to what extent the strategies are effective in controlling energy intake and weight loss in the long term, especially in overweight and obese participants.

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