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ORIGINAL ARTICLE

Appearance-based health promotion messages for increasing fruit and vegetable consumption: gender, age and adverse effects

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Abstract

Aim This study sought to investigate the effects of body-weight-based compared to health-based public health messages for encouraging fruit and vegetable consumption, dependent on gender and age, while also gauging adverse consequences.

Subject and methods Using an independent groups design, male and female participants, aged 18–65 years, were randomized to view either a weight-based ($N = 245$) or a health-based ($N = 231$) public health message for increasing fruit and vegetable consumption, and intentions to consume, immediate selection and subsequent consumption of fruit and vegetables and biscuit/cake-bars, adverse consequences and various confounders were assessed.

Results Weight-based messages resulted in greater immediate selection and subsequent fruit and vegetable consumption compared to health-based messages in females (smallest Beta = 0.375, $p = 0.04$), specifically younger females (least significant Beta = 0.683, $p = 0.04$). No effects were found in males. Intentions to consume fruit and vegetables, biscuit/cake-bars and subsequent biscuit/cake-bar consumption were predicted only by confounders. Adverse consequences of the messages were low ($\chi^2(1) = 44.16$, $p < 0.05$; smallest $t(148) = 10.22$, $p < 0.01$), and did not differ between weight-based and health-based messages ($\chi^2(2) = 2.72$, $p > 0.05$; largest $t(278) = 0.75$, $p = 0.46$).

Conclusions This work demonstrates a role for weight-based compared to health-based public health promotion messages for increasing fruit and vegetable selection and consumption in young females. Adverse consequences following the messages were low, but care may still be needed.

Keywords Fruit and vegetables · Healthy eating · Appearance · Body-weight · Health promotion

Introduction

Low fruit and vegetable (FV) consumption is a major public health concern. FV consumption is associated with reduced risk from a number of global health concerns, including cardiovascular disease, type II diabetes, and obesity (Aune et al. 2017; Oyebode et al. 2014; Tohill 2005; World Health Organisation (WHO) 2003), yet FV consumption across Western populations is low (European Food Safety Authority (EFSA) 2021; Public Health England (PHE) 2020; United States Department of Agriculture (USDA) 2021). In the UK, adults are reported to consume an average 286 g FV/day (PHE 2020), compared to WHO recommendations of 400 g FV/day. Average consumption in Europe is reported at 386 g FV/day (EFSA 2021) and average consumption in the USA totals 2.39 cups FV/day compared to a recommended 3.5–5 cups FV/day (USDA 2021).

Possibly the most well-known public health strategy targeting FV consumption is the promotion to 'Eat 5 FV a day' (National Health Service (NHS) 2020) or variations of this message around the world. Populations seem largely aware of these messages (Appleton et al. 2018a; Ashfield-Watt 2006; Carter et al. 2010; Herbert et al. 2010; Rooney et al. 2017), but implementation remains low (EFSA 2021; PHE 2020; USDA 2021). Low adherence to the recommendations has been associated with poor understanding of the details of the message, such as portion sizes (Appleton et al.

Article in a tweet This work demonstrates higher fruit and vegetable selection and consumption following a body-weight-based compared to health-based health promotion message, with stronger effects in young females. Messages were also rated positively and reported adverse consequences were low.

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2018a; Ashfield-Watt 2006; Carter et al. 2010; Chapman et al. 2016; Dibsdall et al. 2002; Herbert et al. 2010; Rooney et al. 2017), and poor understanding of the reasons for the message (Appleton et al. 2018a; Carter et al. 2010; Chapman et al. 2016; Dibsdall et al. 2002).

Well recognized and commonly reported reasons for consuming FV are health benefits (Carter et al. 2010; Chapman et al. 2016; Dibsdall et al. 2002; Herbert et al. 2010). While these reasons are accurate (Aune et al. 2017; Oyebode et al. 2014; Tohill 2005; WHO 2003), the absence of sufficient action by the population suggests that health-based reasons may not be motivating. FV, however, are also beneficial for body-weight, both as energy-dilute foods for those who are overweight (Tohill 2005; WHO 2003) and as often acceptable nutritious foods for those who are underweight (National Institutes of Clinical Excellence 2021), and considerable research demonstrates a value for appearance-oriented strategies for promoting health behaviours (Appleton 2016; Dempster et al. 2006; Flett et al. 2013; Grogan et al. 2011; Jones and Leary 1994; Persson et al. 2018; Sallis et al. 2019; Smith Kholn and Rogers 1991; Williams et al. 2013). Improved attitudes and intentions towards safe sun behaviours, smoking cessation, alcohol reduction, healthy eating and exercise have all been found in response to appearance-oriented interventions (Dempster et al. 2006; Flett et al. 2013; Grogan et al. 2011; Jones and Leary 1994; Persson et al. 2018; Sallis et al. 2019; Smith Kholn and Rogers 1991; Williams et al. 2013), and corresponding behaviours are also found (Flett et al. 2013; Persson et al. 2018; Sallis et al. 2019; Williams et al. 2013). We also recently demonstrated the value of a weight-based, compared to a health-based, public health message for increasing fruit selection and subsequent consumption (Appleton 2016).

Appearance-oriented strategies however, can be criticized as likely to appeal to only certain members of the population, specifically those who are more appearance-oriented, or who are from certain population subgroups which are likely to be motivated by appearance, such as young females (Appleton 2016; Flett et al. 2013; Grogan et al. 2011; Jones and Leary 1994; Persson et al. 2018).

While FV consumption does not appear to meaningfully impact other aspects of appearance, such as skin attractiveness or clarity (Appleton et al., 2018b), weight-based messages can also be criticized for encouraging weight-related concerns, such as poor body image, weight biases and poor psychological health (Lewis et al. 2010; Puhl et al. 2013a, b; Puhl and Suh 2015; Simpson et al. 2019). For some individuals, poor body image, weight-based concerns and related psychological processes can also contribute to clinical conditions, such as body dysmorphic disorder and eating disorders, such as anorexia nervosa (Burrows 2013; Treasure 2012). Many influences are involved in the development and maintenance of these clinical conditions, and while biological and familial factors are known to play a major role, some impact is also suggested from the wider social and cultural environment (Burrows 2013; Treasure 2012). The development of weight-related concerns and the processes that result in negative impacts are complex (Burrows 2013; Lewis et al. 2010; Puhl et al. 2013b; Puhl and Suh 2015; Treasure 2012), but there may be limited value to addressing one public health concern (low FV consumption) by creating another (negative consequences of weight-based concerns and stigma).

To address these concerns, this work aimed to investigate the impacts of a weight-based public health promotion message for encouraging FV consumption across the population, while also assessing adverse effects. In a replication of our previous study, effects of a simple weight-based public health promotion message were compared to those of a health-based message for encouraging FV consumption in males and females of a range of ages. Adverse consequences were simultaneously investigated using quantitative and qualitative methodologies.

Methods

Design

Using an independent-groups design, male and female participants from a range of ages were randomly assigned to view one of two health promotion poster messages, on a single occasion, and intentions to snack on FV, immediate FV snack selection and subsequent FV consumption were assessed. Adverse effects of poster viewing were assessed immediately after poster viewing, and after assessment of other outcomes. Various background details relevant to FV consumption were also assessed, as was biscuit/cake-bar consumption as a control. An overview of the study is given in Fig. 1.

Participants

Participants were recruited from across the UK from students, staff and research participant pools associated with Bournemouth University, from personal contacts and social media and from businesses and communities local to Bournemouth University, to gain a mix of individuals with a range of ages. Only individuals aged 18–65 years were invited to take part, to limit the study to adults, but there were no other exclusion criteria to increase ecological validity. Older adults (over the age of 65 years) were excluded because body weight concerns can vary in older adults due to natural age-related declines in energy intake. Participants were unaware of the true purpose of the study, and to reduce demand characteristics, information sheets promoted the

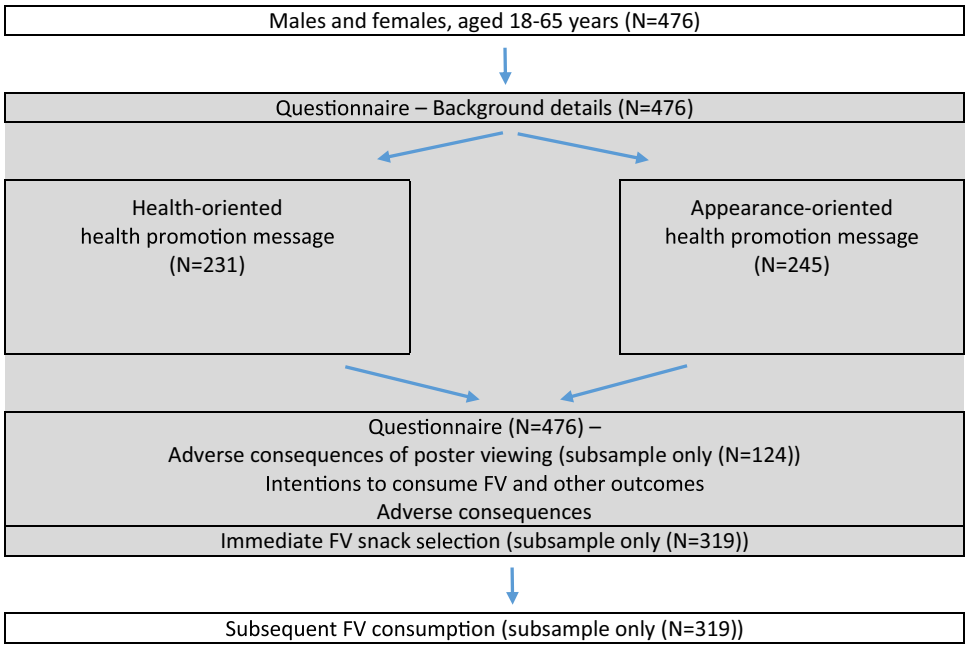

Fig. 1 Overview of the study. N, number of participants invited to contribute data; FV, fruit and vegetables; Shaded aspects completed on a single occasion; Subsequent FV consumption requested 2 days later

study as investigating 'individual preferences for posters for a range of health behaviours'. Ethical approval for the study was given by the Research Ethics Committee of Bournemouth University, UK (ID: 9637), prior to commencement, and the study was conducted with full adherence to the Ethical Principles of the British Psychological Society.

Health promotion messages

Participants viewed one of three health-based messages: *'Eat fruits and vegetables for your heart', 'Eat fruits and vegetables to reduce your risk of cardiovascular disease', and 'You can look after your heart by eating five fruits and vegetables each day*', or one of three weight-based messages: '*Eat fruits and vegetables for your body weight', 'Eat fruits and vegetables to reduce your risk of obesity', and 'You can look after your body weight by eating five fruits and vegetables each day'*. Messages were designed to be simple, positive, gain-framed, to detail the required behaviour to 'Eat fruits and vegetables', and to provide a reason for this that was health- and weight-based. Each message was displayed on a poster, where the message was centrally placed and surrounded by coloured pictures of a range of fruit and vegetables. No other words were included. All posters were identical, excepting the central message. Participants viewed only one message/poster. Poster to be viewed was automatically selected at random by the online survey software presenting the study, and remained concealed during all outcome assessments. Participants were not blinded to poster message, but were blinded to the possible alternatives. Participants were given as long as they wished to complete the study, which included as long as they wished to view the poster. Unlimited time was given to increase the ecological validity of the study. Poster viewing was ensured by the requested completion of several questions on poster perception, such as the message and FV included.

FV consumption: intentions, immediate selection, subsequent consumption

Intentions to consume FV were assessed immediately after poster viewing using two intention questionnaire items – '*I intend to snack on fruits and vegetables tomorrow'* and '*I am likely to snack on fruits and vegetables tomorrow'*; response format: 7-point Likert scale anchored from '*strongly disagree'* – '*strongly agree',* scored –3 to +3 (low-high). Snacking on FV was investigated as a behaviour with health benefits, which may be more amenable to change than FV consumption in general, based on usual use and dietary practices (Appleton et al. 2016; Glasson et al. 2011).

Immediate FV selection was assessed by offering participants a choice of one of eight snacks on completion of the study as a token of thanks: four items of fruit – two apples, two bananas; and four non-fruit-based biscuit/cake-bars – two golden oats Kellogg's Elevenses, two ginger bake Kellogg's Elevenses. The cake bars were considered comparable to the fruit snacks in usual use, and deliberately did not include chocolate to avoid selection of certain snacks specifically as a reward or treat. Snack selection was observed covertly by the researcher, prior to the participant leaving the test situation. No snack was also permitted as a choice. Immediate FV selection was only offered for a subgroup of the population sampled.

Subsequent FV consumption was assessed by self-report by email, in response to an email sent two days later, requesting '*number of portions of fruits and vegetables consumed yesterday'*. A two day period was chosen to maximize the capture of any effects as a result of a single viewing of the health promotion message. Responses to the follow-up email were limited to a five day period, to ensure direct relevance to the study. Email responses received after five days (and so over one week after poster viewing) were discarded and not used for analysis. Subsequent FV consumption was also only requested in a subgroup of the population sampled.

Adverse effects of poster viewing

Adverse effects of poster viewing were assessed firstly immediately after poster viewing as 'first reaction' to the poster using an open response question '*How do you feel after viewing this poster?'*. Only a subgroup of the sample were asked to provide these qualitative comments. Adverse effects of poster viewing were also assessed in the sample as a whole using four questions at the end of the questionnaire: *'Thinking about my health has upset me', 'Thinking about my body-weight has upset me', 'Has the poster affected you in a negative way?', 'Did you think the poster was insensitive?'*. Questionnaire items were responded to on a 7-point Likert scale *('not at all' – 'extremely'),* and summed to result in a score from –3 to +3 (low-high).

FV consumption: participant characteristics of potential impact

Various characteristics of potential impact on FV consumption (Appleton 2016; Appleton et al. 2010, 2017, 2019; De Bruijn et al. 2007; De Bruijn 2010; Herbert et al. 2010) were also assessed using additional questionnaire items, and subsequently controlled for to prevent confounding. These characteristics were: past FV consumption ('*Yesterday, how many portions of fruits and vegetables did you eat?*'); usual FV consumption ('*On an average week day, how many portions of fruits and vegetables do you eat?', 'On an average weekend day, how many portions of fruits and vegetables do you eat?'*); liking for FV *('I like fruits and vegetables' (strongly disagree – strongly agree)*); usual importance of health ('*How important is your health to you?' (not at all – extremely important)*; usual importance of body-weight ('*How important is your weight to you?' (not at all – extremely important)*; usual importance of others *('I would be affected if someone criticized my diet' (strongly disagree – strongly agree), 'What other people think of my diet matters to me' (strongly disagree – strongly agree)*); attitudes towards FV ('*My snacking on fruits and vegetables tomorrow would be: unpleasant – pleasant; unenjoyable – enjoyable; worthless – valuable; harmful – beneficial'*); self-efficacy over FV consumption *('If I wanted to, I would not have problems succeeding to snack on fruits and vegetables tomorrow' (strongly disagree – strongly agree), 'How confident are you that you could snack on fruits and vegetables tomorrow?' (not at all – completely confident)*); and perceived behavioral control over FV consumption ('*How much control do you feel over whether or not you snack on fruits and vegetables tomorrow?' (none at all – complete control), 'I feel in complete control of whether or not I snack on fruits and vegetables tomorrow' (strongly disagree – strongly agree*)), all scored –3 to +3 (low-high).

The Theory of Planned Behaviour (TPB) (Ajzen 2002) was used as a theoretical framework for the study, hence the use of some constructs, but the study was not a specific test of the Theory of Planned Behaviour. Attitudes, self-efficacy and perceived behavioural control were assessed after poster viewing as possible routes through which the posters may impact on intentions (Ajzen 2002; De Bruijn et al. 2007; De Bruijn 2010). All other participant characteristics were assessed prior to poster viewing. Past and usual FV consumption were measured in portions consumed/day. All other questionnaire items were responded to on a 7-point Likert scale, and summed where appropriate, to result in a score from –3 to +3 (low-high) per characteristic. To reduce demand characteristics, alongside promotion of the study as investigating individual preferences, a range of distractor questions were also included throughout the questionnaire. Distractor questions included questions on poster perception and preferences, artistic abilities and preferences, and other aspects of diet and lifestyle. The full questionnaire is provided in the Supplementary Materials. All questionnaire items were provided using an online survey tool (Surveymonkey – www.surveymonkey.com). All questions and measures were based on previous publications (Adams et al. 2015; Appleton 2016; Rennie et al. 2014).

Biscuit/cake-bar consumption: intentions, subsequent consumption and participant characteristics

Equivalent measures of biscuit/cake-bar (BCB) consumption were also undertaken, as a measure of unhealthy snacking behaviour, to ensure all effects of the messages were FV-specific. Biscuit/cake-bars were defined at their first mention, as '*any individual or individually wrapped biscuit- or cake-based snack item, such as flapjacks, Jaffa cake bars, Nutrigrain bars, 2-finger Kitkats, etc.*'. Subsequent consumption was again assessed only in a subgroup of the sample. Intentions to consume BCB, subsequent BCB consumption and related participant characteristics (past consumption, usual consumption, liking for BCB, attitudes towards BCB,

self-efficacy for and perceived behavioural control over BCB consumption) were assessed using the equivalent questionnaire measures and email requests as for FV.

Procedure

Participants undertook the study individually, on a single occasion that took place at Bournemouth University, at the premises of local businesses or online from November 2015–April 2018. Participants completed aspects of the study in the following order: 1. read all information and provide informed consent; 2. complete questions on background details; 3. view a public health promotion message; 4. complete questions on outcomes; 5. select a snack as a token of thanks; 6. return an email response to an email sent two days later; 7. receive a debrief and explanation of the study by return email (or two weeks after study participation if an email response had not been received). All participants were asked to complete all questionnaire measures, 319 participants undertook the study in person and were invited to take part in measures of immediate FV selection, subsequent FV and BCB consumption, and 124 participants were invited to offer qualitative comments on 'first reaction' to the poster. Fewer participants were asked to take part in these aspects of the study to limit participant burden.

Analyses

All FV and BCB outcomes were investigated using multiple linear regression. Outcomes were predicted by message-type (health-based/weight-based) and all participant characteristics (Howell 1997). To investigate differential effects of the poster messages by age, age and an interaction term for message-type*age were included in all models (Breitborde et al. 2010; Preacher et al. 2006). To investigate differential effects of the message-types by gender, separate models were run for males and females. This was done to avoid requirements for three-way interaction terms of message type*age*gender and the difficulties of interpreting these (Breitborde et al. 2010; Preacher et al. 2006). For immediate FV selection, snacks selected were converted into number of portions of FV selected where fruit = 1, and non-fruit-based biscuit/cake-bars = 0; and subsequent self-reported FV/BCB consumption was recorded as number of portions. Correlations between all variables in advance of completion of the regression analyses revealed concerns over multi-collinearity between FV self-efficacy and FV perceived behavioural control (r = 0.72), thus all analyses were conducted with FV self-efficacy only. Separate models were conducted for each outcome variable. Sample sizes were based on planned regression analyses (Howell 1997). Adverse effects of poster viewing were analysed using multiple linear regression as above, and also using one-sample t-tests per message-type to assess for differences from 0 or 'no effect', and using one-way ANOVA for differences between message-types. Qualitative responses for 'first reaction' were coded independently and agreed by two researchers who were blinded to poster condition, as 'positive', 'motivating', 'negative', 'demotivating' or 'neither positive nor negative'. Number of 'positive', 'motivating', 'negative' and 'demotivating' responses per message-type were compared using Chi-squared tests. All participants provided questionnaire data and were included in analyses on intentions to consume FV/BCB and adverse effects of poster viewing. All responding participants were included in analyses on immediate FV selection, subsequent self-report FV/BCB consumption and 'first reaction' to the poster. Analyses were conducted in IBM SPSS. Significance was set at $p < 0.05$.

Results

In total, 476 participants took part: 196 (41%) males, 280 (59%) females, where 128 (27%) participants were aged 18–20 years, 175 (37%) participants were aged 21–30 years, 58 (12%) participants were aged 31–40 years, 68 (14%) participants were aged 41–50 years and 47 (10%) participants were aged 51–65 years. Of these, 231 participants were randomized to view a health-based message, and 245 participants were randomized to view a weight-based message. Details of all participant characteristics are given in Table 1. Females reported higher past and usual FV consumption, higher FV liking, lower BCB consumption, and greater importance of health, body-weight and the opinions of others, than males (smallest $t(474) = 2.23$, $p = 0.03$).

All 476 participants completed the questionnaire measures on background characteristics, FV and BCB intentions and adverse effects; 294 (92%) participants provided data on FV selection and 261 (82%) participants provided data on subsequent FV and BCB consumption. Reasons for failure to respond are unknown. Of the 124 participants asked, 100% provided qualitative comments on 'first reaction' to the poster. Descriptive statistics for all outcomes are given in Table 2. Intentions to consume BCB, immediate BCB selection at the end of the study and subsequent BCB consumption were lower following the weight-based, compared to the health-based message (smallest $t(292) = 2.49$, $p = 0.01$). Females also had more positive attitudes towards FV, higher related self-efficacy and perceived

Table 1 Participant background characteristics (mean (SD)), in males and females, by message-type

	Males ($N = 196$)		Females ($N = 280$)	
	Health-based ($N = 100$)	Weight-based ($N = 96$)	Health-based ($N = 131$)	Weight-based ($N = 149$)
Age (years)	29.7 (13.0)	30.2 (14.1)	28.6 (11.5)	30.9 (12.2)
Past FV consumption (portions)	2.4 (1.3)	2.7 (1.5)	2.9 (1.7)	3.1 (1.9)
Usual FV consumption (portions)	3.0 (2.0)	3.1 (1.3)	3.7 (1.8)	3.8 (1.7)
Liking for FV (–3 to +3)	1.6 (1.3)	1.7 (1.1)	2.1 (1.1)	2.1 (1.1)
Past BCB consumption (portions)	1.3 (1.4)	1.1 (1.4)	1.0 (1.1)	0.9 (1.2)
Usual BCB consumption (portions)	1.6 (1.1)	1.3 (1.1)	1.6 (1.4)	1.4 (1.1)
Liking for BCB (–3 to +3)	1.7 (1.2)	1.2 (1.6)	1.3 (1.7)	1.6 (1.4)
Importance of health (–3 to +3)	2.1 (0.9)	2.1 (0.9)	2.2 (0.8)	2.4 (0.8)
Importance of body-weight (–3 to +3)	1.3 (1.4)	1.6 (1.2)	1.9 (1.0)	2.1 (0.9)
Importance of others (–3 to +3)	–1.3 (1.3)	–1.4 (1.3)	–0.5 (1.4)	–0.4 (1.4)

FV, fruit and vegetable; *BCB*, biscuit/cake bar

Table 2 Intentions to consume FV/BCB, FV selection, subsequent FV/BCB consumption, and adverse effects of the message (mean (SD) or N), in males and females, by message-type

	Males (N = 196)		Females (N = 280)	
Questionnaire	Health-based (N = 100)	Weight-based (N = 96)	Health-based (N = 131)	Weight-based (N = 149)
FV: Intentions (–3 to +3)	1.5 (1.2)	1.5 (1.2)	1.7 (1.3)	1.7 (1.3)
FV: Attitudes (–3 to +3)	1.7 (1.2)	1.7 (1.1)	2.2 (0.8)	2.2 (0.8)
FV: Perceived Behavioural Control (–3 to +3)	1.7 (1.2)	1.7 (1.1)	2.0 (1.2)	1.9 (1.1)
FV: Self-efficacy (–3 to +3)	1.4 (1.4)	1.6 (1.2)	2.0 (1.1)	1.8 (1.3)
BCB: Intentions (–3 to +3)	0.5 (1.6)	–0.1 (1.6)	–0.6 (1.6)	–0.8 (1.6)
BCB: Attitudes (–3 to +3)	0.1 (1.1)	–0.1 (1.1)	0.0 (1.2)	0.1 (1.2)
BCB: Perceived behavioural control (–3 to +3)	1.4 (1.3)	1.1 (1.5)	1.3 (1.4)	1.2 (1.6)
BCB: Self-efficacy (–3 to +3)	1.2 (1.4)	0.8 (1.6)	1.0 (1.4)	1.0 (1.3)
Adverse effects (–3 to +3)	–2.3 (1.2)	–2.4 (1.6)	–1.6 (1.6)	–1.5 (1.7)
Follow-up	Health-based (N = 80)	Weight-based (N = 80)	Health-based (N = 80)	Weight-based (N = 79)
Immediate selection	Health-based (N = 77)	Weight-based (N = 69)	Health-based (N = 75)	Weight-based (N = 73)
Immediate snack selection	Fruit = 44; Cake bar = 33	Fruit = 45; Cake bar = 24	Fruit = 42; Cake bar = 33	Fruit = 55; Cake bar = 18
Subsequent consumption	Health-based (N = 56)	Weight-based (N = 55)	Health-based (N = 75)	Weight-based (N = 75)
FV: 2 days later (portions)	3.0 (1.0)	2.8 (1.5)	3.3 (1.3)	3.4 (1.2)
BCB: 2 days later (portions)	1.5 (1.5)	0.9 (1.0)	1.0 (0.7)	0.8 (0.8)

FV, fruit and vegetable; *BCB*, biscuit/cake bar

behavioural control, greater subsequent FV consumption, higher adverse consequences and lower intentions to consume BCB and subsequent BCB consumption, than males (smallest $t(259) = 2.22$, $p = 0.03$).

Effects of the health promotion messages

Results from all regression analyses for males and females are given in Tables 3 and 4, respectively. In males, no outcomes

Table 3 FV/BCB intentions, selection and subsequent consumption, and adverse effects: results of regression analyses in males

	Intentions to consume FV		Immediate FV selection		Subsequent FV consumption		Intentions to consume BCB		Subsequent BCB consumption		Adverse effects	
	R^2=0.62, adj. R^2=0.58, F(17,195)=16.73, p<0.01		R^2=0.32, adj. R^2=0.23, F(17,145)=3.60, p<0.01		R^2=0.59, adj. R^2=0.52, F(17,110)=8.00, p<0.01		R^2=0.60, adj. R^2=0.56, F(17,195)=15.36, p<0.01		R^2=0.60, adj. R^2=0.53, F(17,110)=8.16, p<0.01		R^2=0.16, adj. R^2=0.08, F(17,195)=2.00, p=0.01	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Condition[1]	.043	.70	.061	.74	–.099	.55	–.058	.63	–.181	.28	.075	.66
Age	.115	.47	.138	.59	.081	.75	–.023	.89	–.021	.93	.112	.63
Condition[1] x age	–.154	.42	–.025	.94	–.038	.89	–.061	.75	.077	.78	–.129	.64
Past FV intake	**.153**	**.02**	–.022	.83	**.486**	**<.01**	.066	.30	**.246**	**.02**	**–.190**	**.04**
Usual FV intake	–.068	.27	–.011	.90	**.193**	**.02**	–.109	.08	–.118	.16	.138	.13
FV liking	.061	.47	.013	.93	–.033	.80	.052	.54	.081	.52	.223	.07
Past BCB intake	.041	.56	**–.231**	**.05**	–.046	.67	.061	.39	**.681**	**<.01**	.060	.56
Usual BCB intake	.005	.95	.007	.95	.047	.67	**.258**	**<.01**	.025	.82	–.028	.78
BCB liking	.096	.14	–.020	.84	**–.221**	**.03**	**.168**	**.01**	–.131	.18	.098	.30
Important health	.093	.13	.060	.54	.048	.63	.008	.89	.017	.87	–.105	.25
Important weight	–.040	.51	–.046	.64	.103	.26	.026	.68	–.044	.63	.012	.90
Important others	**–.110**	**.05**	**.205**	**.03**	.084	.35	**–.181**	**<.01**	.031	.72	**.230**	**.01**
FV attitudes	**.446**	**<.01**	–.032	.84	–.069	.65	–.150	.08	–.184	.22	–.043	.73
FV self-efficacy	**.248**	**<.01**	.140	.28	.195	.09	.090	.20	.047	.68	–.029	.77
BCB attitudes	**–.152**	**.02**	**–.291**	**<.01**	.095	.37	**.307**	**<.01**	.093	.38	–.168	.08
BCB self-efficacy	.015	.82	.003	.98	–.029	.77	.129	.06	.072	.47	.075	.44
BCB PBC	.061	.31	–.141	.19	.102	.30	.069	.26	–.082	.40	.074	.41

[1]Condition: 1 = health-based, 2 = weight-based. FV, fruit and vegetable, BCB, biscuit/cake bar; PBC, perceived behavioural control. Significant findings ($p < 0.05$) highlighted in bold

were affected by message-type, age or an interaction between these (largest Beta = –0.181, $p = 0.28$). Higher FV intentions were associated with higher past FV intakes, more positive FV attitudes and higher FV self-efficacy, more negative BCB attitudes and a lower importance of others (smallest Beta = –0.110, $p = 0.05$). Higher immediate FV selection was associated with lower past BCB intakes, more negative BCB attitudes and a higher importance of others (least significant Beta = –0.231, $p = 0.05$). Higher subsequent FV consumption was associated with higher past FV intakes, higher usual FV intakes and lower liking for BCB (least significant Beta = –0.221, $p = 0.03$). Higher BCB intentions were associated with higher usual BCB intakes, higher liking for BCB, more positive BCB attitudes and a lower importance of others (smallest Beta = 0.168, $p = 0.01$). Higher subsequent BCB consumption was associated with higher past FV intakes and higher past BCB intakes (smallest Beta = 0.246, $p = 0.02$).

In females, greater immediate FV consumption and greater subsequent FV consumption were associated with viewing the weight-based message, compared to the health-based message (smallest Beta = 0.375, $p = 0.04$). Interactions between message-type and age also revealed greater effects of the weight-based message in younger females in measures of immediate FV selection, and lesser effects of the weight-based message in older females in measures of subsequent FV consumption (smallest Beta = 0.589, $p = 0.03$). Post-hoc subgroup analyses, conducted per age group, revealed significantly greater FV selection after the weight-based poster in the 18–20 years age group ($t(50) = 3.30$, $p < 0.01$), and significantly greater subsequent FV consumption after the health-based poster in the 51–65 years age group ($t(8) = 2.51$, $p = 0.04$). Demonstration of the interaction effect is given in Fig. 2.

Greater immediate FV consumption was also associated with higher age and a lower usual BCB consumption (least significant Beta = 0.573, $p = 0.03$). Greater subsequent FV consumption was also associated with a higher age, a higher past FV intake, a higher usual FV intake, and a lower usual BCB consumption (least significant Beta = 0.605, $p = 0.01$). In other outcomes, higher FV intentions were associated with higher past FV intake, higher liking for FV, more positive FV attitudes and higher FV self-efficacy (smallest Beta = 0.113, $p = 0.03$). Higher intentions to consume BCB were associated with higher age, lower usual FV intake, lower FV attitudes, and higher past BCB intake, usual BCB intake, liking for BCB, and more positive BCB attitudes (smallest Beta = –0.115, $p = 0.05$). Greater subsequent BCB consumption was associated with more positive BCB attitudes and lower perceived control over BCB consumption (smallest Beta = 0.224, $p = 0.01$).

Table 4 FV/BCB intentions, selection and subsequent consumption, and adverse effects: results of regression analyses in females

	Intentions to consume FV		Immediate FV selection		Subsequent FV consumption		Intentions to consume BCB		Subsequent BCB consumption		Adverse effects	
	R^2=0.56, adj. R^2=0.53, F(17,279)=19.38, p<0.01		R^2=0.27, adj. R^2=0.17, F(17,147)=2.81, p<0.01		R^2=0.46, adj. R^2=0.38, F(17,149)=6.54, p<0.01		R^2=0.45, adj. R^2=0.43, F(17,279)=12.73, p<0.01		R^2=0.42, adj. R^2=0.34, F(17,149)=5.56, p<0.01		R^2=0.30, adj. R^2=0.26, F(17,279)=6.73, p<0.01	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Condition[1]	.110	.34	**.611**	**<.01**	**.375**	**.04**	.140	.27	.097	.60	–.057	.69
Age	.135	.34	**.573**	**.03**	**.605**	**.01**	**.363**	**.02**	.447	.06	.004	.98
Condition[1] x age	–.191	.30	**–.683**	**.04**	**–.589**	**.03**	–.387	.06	–.379	.18	.137	.56
Past FV intake	**.251**	**<.01**	.058	.52	**.351**	**<.01**	.104	.09	.069	.41	–.014	.84
Usual FV intake	.018	.74	.038	.68	**.231**	**<.01**	**–.115**	**.05**	.066	.42	**.136**	**.04**
FV liking	**.113**	**.03**	.034	.70	–.096	.21	.016	.78	–.079	.33	.072	.26
Past BCB intake	.076	.11	.119	.21	.085	.30	**.219**	**<.01**	.078	.36	–.112	.06
Usual BCB intake	–.019	.69	**–.318**	**<.01**	**–.225**	**<.01**	**.192**	**<.01**	.150	.07	–.047	.44
BCB liking	–.044	.38	–.084	.37	–.038	.65	**.161**	**<.01**	.118	.18	.035	.58
Important health	.072	.18	–.085	.38	.137	.10	.050	.40	.135	.12	**–.161**	**.02**
Important weight	.085	.08	–.039	.68	.000	.99	–.026	.64	–.084	.32	–.084	.17
Important others	.068	.16	.088	.34	.076	.35	–.024	.66	.046	.58	**.355**	**<.01**
FV attitudes	**.351**	**<.01**	–.005	.96	.033	.69	**–.134**	**.03**	.108	.20	–.127	.07
FV self-efficacy	**.179**	**<.01**	.144	.14	.064	.44	.039	.51	–.074	.39	**–.181**	**.01**
BCB attitudes	–.069	.17	–.059	.53	.009	.92	**.276**	**<.01**	**.224**	**.01**	–.008	.90
BCB self-efficacy	–.028	.58	–.177	.07	.030	.73	.104	.06	.122	.18	**.142**	**.02**
BCB PBC	–.006	.91	.005	.96	–.094	.27	–.071	.20	**–.277**	**<.01**	.060	.34

[1]Condition: 1 = health-based, 2 = weight-based. FV, fruit and vegetable, BCB, biscuit/cake bar; PBC, perceived behavioural control. Significant findings ($p < 0.05$) highlighted in bold

Adverse effects

All qualitative comments on the posters are provided in the Supplementary Materials. Number of 'positive' and 'motivating' comments for both posters (health-based: positive n = 26; motivating n = 16; weight-based: positive n = 22; motivating n = 12) were higher than the number of 'negative' and 'demotivating' comments (health-based: negative n = 9; demotivating n = 0; weight-based: negative n = 4; demotivating n = 0) ($\chi^2(1) = 44.16$, $p < 0.05$), and there were no differences between health-based and weight-based messages ($\chi^2(2) = 2.72$, $p > 0.05$).

Using the quantitative data (Table 2), mean scores for adverse effects for males and females for both message types were significantly lower than the mid-point of the scale (smallest $t(148) = 10.22$, $p < 0.01$), and no differences were found between poster message types (largest $t(278) = 0.75$, $p = 0.46$).

In regression analyses, in males (Table 3), greater adverse effects were associated with lower past FV intakes and a

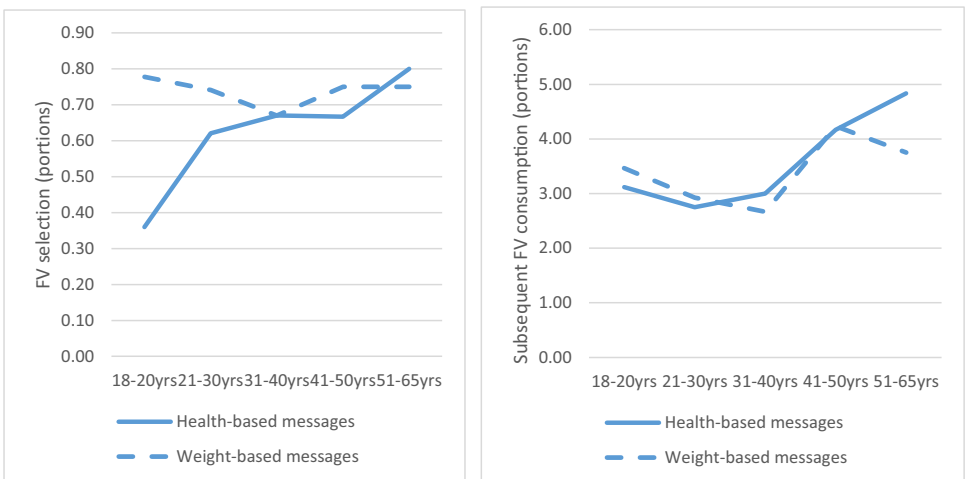

Fig. 2 Interaction effects between message type and age in **a** Immediate FV selection (mean no. of portions) and **b** Subsequent FV consumption (mean no. of portions). FV, fruit and vegetables

higher importance of others (smallest Beta = –0.190, p = 0.04). In females (Table 4), greater adverse effects were associated with higher usual FV intakes, lower FV self-efficacy, and higher BCB self-efficacy, a lower importance of health and a higher importance of others (smallest Beta = 0.136, p = 0.04). There were no associations with message-type (largest Beta = 0.137, p = 0.56).

Discussion

This study investigated the effects of a weight-based, compared to a health-based, public health promotion message for encouraging FV consumption in males and females of a range of ages. No effects of the health promotion messages were found in males. In females, however, greater FV selection was found immediately after viewing the weight-based health promotion message and greater FV consumption was reported two days after taking part in the study. These findings duplicate the findings of our previous study, and demonstrate a value for weight-based messages for impacting eating behaviour.

The impact of appearance-oriented health promotion messages for changing health behaviours has been previously demonstrated, as discussed in the introduction (Flett et al. 2013; Persson et al. 2018; Williams et al. 2013). Greater effects of the weight-based health promotion messages were also found in females, compared to males. These stronger effects may demonstrate the increased importance of body-weight for females (Grymislawska et al. 2020; Robinson et al. 2022; Wardle et al. 2004, 2006), a higher concern over body-weight (Grymislawska et al. 2020; Robinson et al. 2022; Wardle et al. 2004, 2006), and/or differences such that it is often considered more acceptable for females to be concerned about their body-weight than males (Grymislawska et al. 2020; Robinson et al. 2022; Wardle et al. 2004, 2006). A greater consumption of a healthy diet, a higher consumption of FV, a stronger association between diet and body-weight, and the greater consumption of a healthy diet in order to impact body-weight are also reported more in females compared to males (EFSA 2021; Grymislawska et al. 2020; PHE 2020; USDA 2021; Wardle et al. 2004, 2006). Our findings also demonstrate the increased consumption of FV and related more positive attitudes and other variables, in females compared to males.

Stronger effects of the weight-based messages were also found in younger females, while lesser effects were found in older females. These findings may again reflect greater concerns over body weight in younger compared to older individuals (Gravener et al. 2008; Richard et al. 2016; Robertson et al. 2014), although concerns over the appearance-related aspects of body-weight have been reported at all ages (Richard et al. 2016; Robertson et al. 2014). Repeated research, however, also suggests that older compared to younger individuals are more concerned over health, and typically consume or are more inclined to consume a certain diet for health reasons (Robertson et al. 2014; Jovicic 2015). This increased interest in healthy eating is reflected in our main effects of age, as demonstrated in Fig. 2, where greater FV selection and subsequent consumption were found with a higher age. Increased FV consumption with age is well recognised (Lee-Kwan et al. 2017; NHS Digital 2020; Oyebode et al. 2014).

The weight-based messages were also not found to result in increased adverse effects. Importantly, adverse effects were low following both message-types, more positive and motivating comments than negative and demotivating comments were reported on first reaction to all posters, and no differences were found between the weight-based and health-based messages. Some caution, however, may be required considering a possible role for emphasizing appearance and body-weight in the development of poor health in individuals with eating- and weight-based conditions (Puhl et al. 2013a, b; Simpson et al. 2019). Several studies find reduced health and health care behaviours when individuals feel stigmatized for their weight (Puhl et al. 2013a), and some of these studies have found associations with specific terms or public health messages (Puhl et al. 2013a, b; Simpson et al. 2019). These studies suggest preferences for more neutral terms relating to 'weight', as opposed to terms related to 'excess weight', such as 'obesity' (Puhl et al. 2013a), negative impacts from negative emotive language, particularly language that implies blame (Lewis et al. 2010; Puhl et al. 2013a, 2013b; Simpson et al. 2019), and more positive perceptions of messages that focus on healthy behaviours and include a behavioural element (Lewis et al. 2010; Puhl et al. 2013b; Simpson et al. 2019). Not all studies investigating messages that target body-weight, however, find negative effects (Dixon et al. 2015; Hoyt et al. 2019), and many individual differences are found (Lewis et al. 2010; Puhl et al. 2013b; Hoyt et al. 2019). Studies investigating wider environmental weight-based stimuli also demonstrate individual differences in effects, largely dependent on interpretation and personal relevance (Halliwell 2013; Want 2009). Much of the work suggesting negative effects from weight-based messages has aimed to reduce obesity (Lewis et al. 2010; Puhl et al. 2013a, 2013b; Simpson et al. 2019), and this may have a bearing. Adverse effects were also noticeably associated, in our study, with various FV and BCB variables, including a lower importance of health and a higher importance for others. These findings suggest that any adverse effects may have resulted more from the perceived unimportance of the message, a reactance to being told what to do, and/or the importance of the opinions of others, as opposed to any weight-based element. Work on the specific wording of the message would clearly be of value, as would work

investigating the underlying mechanisms by which weight-based messages impact behaviour. If underlying mechanisms can be identified, strategies focusing on these mechanisms specifically may be of value. The investigation of strategies to reduce weight bias or understand the development and prejudice associated with weight bias will also be of value (Lewis et al. 2010; Puhl and Suh 2015). While we do not wish to replace one health concern with another, the rejection of successful health promotion techniques for some is also unsatisfactory (Dixon et al. 2015; Hoyt et al. 2019).

The weight-based messages were not found to affect intentions to consume FV, intentions to consume biscuit/cake-bars or their subsequent consumption. Intentions were more strongly associated with similar past behaviours, usual behaviours, positive attitudes, increased self-efficacy and increased perceived behavioural control, and these variables were also found to play a role in our consumption outcomes. These variables have all previously been demonstrated to impact FV consumption (Appleton 2016; Appleton et al. 2010, 2017, 2019; Astrom and Rise 2001; De Bruijn et al. 2007; De Bruijn 2010; Blanchard et al. 2009; Bogers et al. 2004; Emanuel et al. 2012). Interestingly, we also find no effects as a result of the importance of body-weight as assessed in our questionnaire. This may have resulted from the obvious nature and social demand characteristics of this question, but further work aiming to understand why weight-based messages may be efficacious, considering underlying mechanisms, would clearly be of value. The differences between the intention and behavioural outcomes also demonstrate the often reported differences between intentions and behaviour in healthy eating (Appleton 2016; Bogers et al. 2004).

Strengths of the study include the large sample size, consideration of a continuous range of ages, and our inclusion of several different outcomes and outcome measures to include measures of behaviour and both qualitative and quantitative measures of adverse effects. As limitations, we were unable to investigate the impacts of specific message wording due to the randomized presentation of all messages, and our study sample may be biased through our recruitment strategy, our use of volunteers and an ethical procedure recommending against participation by those who may be strongly adversely affected by the study. We have no information on those who chose not to take part in the study, and therefore cannot assess the extent of any bias. We also have no 'no message' or 'no FV-specific message' control, but effects of health promotion messages themselves are well known (Gallagher and Updegraff 2011), and an additional demonstration of the benefits of 'a' message was not the purpose of our study. Additional control messages would also have added the need for additional participant groups, and this was considered of limited value. We also have no assessment of the long-term impacts of the messages. Follow-up measures were taken only 2–5 days after message provision, whereas long-term health will only be impacted by sustained behaviour change. While a longer follow-up period following a single exposure to a health message may be unlikely to yield further effects, investigation of the effects of repeated exposure to the health messages would be of value. Messages could be displayed, for example, in canteens, as part of a newsletter, or in public buildings, such as gyms, although careful thought will also be required to ensure sustained attention. Our study however does suggest greater effects on FV consumption in young females through the use of the weight-based messages and greater effects on FV consumption in older females through the use of the health-based messages; thus different messages are likely to be more suitable in different scenarios dependent on the likely clientele.

Conclusions

In conclusion, this work demonstrates a role for weight-based compared to health-based public health promotion messages for increasing fruit and vegetable selection and consumption in females, and particularly in young females. No effects were found in intentions to consume fruits and vegetables or in males. Adverse effects following the messages were low and did not differ between weight-based and health-based messages, but care may still be needed to avoid negative consequences. Further work on message wording, underlying mechanisms and long-term impacts of the messages is required.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10389-022-01746-8.

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Data Availability Data and materials are available from the corresponding author on reasonable request, and are available for public access in Bournemouth University's Open Research Data Repository (BORDaR).

Declarations

Ethics approval Ethical approval for the study was given by the Research Ethics Committee of Bournemouth University, UK (ID: 9637), prior to commencement, and the study was conducted with full adherence to the Ethical Principles of the British Psychological Society.

Consent to participate All participants provided written informed consent.

Consent to publish N/A

Conflicts of interest There are no conflicts of interest to disclose.

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