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Population-based evaluation of the 'LiveLighter' healthy weight and lifestyle mass media campaign

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Abstract

The Western Australian (WA) 'LiveLighter' (LL) mass media campaign ran during June–August and September–October 2012. The principal campaign ad graphically depicts visceral fat of an overweight individual ('why' change message), whereas supporting ads demonstrate simple changes to increase activity and eat healthier ('how' to change message). Cross-sectional surveys among population samples aged 25–49 were undertaken pre-campaign ($N = 2012$) and following the two media waves ($N = 2005$ and $N = 2009$) in the intervention (WA) and comparison state (Victoria) to estimate the population impact of LL. Campaign awareness was 54% after the first media wave and overweight adults were more likely to recall LL and perceive it as personally relevant. Recall was also higher among parents, but equal between socio-economic groups. The 'why' message about health-harms of overweight rated higher than 'how' messages about lifestyle change, on perceived message effectiveness which is predictive of health-related intention and behaviour change. State-by-time interactions showed population-level increases in self-referent thoughts about the health-harms of overweight ($P < 0.05$) and physical activity intentions ($P < 0.05$). Endorsement of stereotypes of overweight individuals did not increase after LL aired. LL was associated with some population-level improvements in proximal and intermediate markers of campaign impact. However, sustained campaign activity will be needed to impact behaviour.

Introduction

The World Health Organization (WHO) described obesity as a global epidemic [1]. In Australia, 35% of adults are overweight and 28% are obese [2]. Similarly high rates are found throughout the developed world [3, 4] increasing people's risk of type 2 diabetes, cardiovascular disease and some cancers [5]. Excess body weight occurs due to an energy imbalance influenced by modifiable lifestyle factors of increased activity and reduced dietary intake [6]. The WHO identified mass media as effective for disseminating messages about obesity prevention to populations [1]. A substantial science base concerning principles of effective media campaigns may be applied to obesity prevention [7].

Previous weight and lifestyle campaigns

Evidence indicates mass media campaigns can positively influence health behaviours [7–9], including physical activity [10–12] and diet [13, 14]. Previous Australian state and national public health campaigns addressed these antecedents of overweight [13, 15–19]. More recently, public health campaigns in Australia [20–24] and elsewhere [25–28] have explicitly addressed overweight. There has also been considerable programming about overweight in mainstream media [29, 30]. The first such published evaluation used Body Mass Index (BMI) as

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the primary response indicator and no evidence of impact was found [31]. The BBC's (United Kingdom) 'Fighting Fit, Fighting Fat' obesity reduction campaign recorded population recall of around one-in-five and behaviour change of 1% [25]. Other campaigns in the Netherlands [26, 28] and United Kingdom [27] successfully increased population awareness, with no marked improvements in behaviour. Australian campaigns [21, 23, 24] achieved unprompted or semi-prompted recall of 16–38%. The first public health campaign to associate abdominal adiposity with cancer risk [22] achieved increased public awareness of this link. Together these results indicate that in the early stages of implementation, obesity prevention mass media campaigns have yielded more impact on proximal variables such as message awareness and understanding than on intermediate impacts such as belief, attitudes and intentions, or on distal impacts such as behaviour or weight change.

Although mass media campaigns have traditionally been designed to change population health behaviours, they may actually exert the greatest, direct influence on crucial preceding attitudinal variables [10, 32] and indirectly influence behaviour by setting the agenda for discussion by the public and policy makers [33]. Health behaviour [34–36], communication theories [37] and prior research [7] indicate levering changes in cognitions and/or emotions offers a route to effecting improvements in health protective behaviours. Considering such processes in planning and evaluating weight and lifestyle campaigns should optimize their persuasive potential.

Previous obesity prevention campaigns have tended to emphasize messages about 'how' to achieve healthy weight through increased activity and healthy eating. Some campaigns have included messages on weight-related chronic disease—typically through voice overs, 'skin deep' representations of people affected by overweight or cartoon-like animations of internal disease processes [38]. Theory suggests designing obesity prevention campaigns to simultaneously 'motivate', 'reinforce' and 'enable' people to achieve change will optimize the chances of impact [39]. Such an approach entails communicating both 'why' and 'how' to change. Evidence from anti-smoking campaigns suggests messages oriented towards providing viewers with information on 'why' they should make health-related behaviour changes are associated with greater recall, perceived effectiveness, attitude, intention and behaviour change [33, 40–44]. Recent evidence also suggests messages about the health consequences of excess body weight accompanied by graphic imagery represent the most persuasive mass media approach to obesity prevention [45].

The 'LiveLighter' campaign

The 'LiveLighter' (LL) campaign is unique for explicitly presenting graphic anatomical images of visceral fat to illustrate negative health effects of overweight, [46–48] alongside recommending alternatives to obesogenic behaviours [49]. Development of LL was informed by a review [50] of best practice approaches to mass media and social marketing campaigns on physical activity, healthy eating and healthy weight [e.g. 1, 9, 37, 51, 52]. Campaign development and evaluation were guided by an applied analysis of behaviours the campaign intended to influence, in light of well-established principles of behaviour change [34–36], synthesized in Rogers [53] and Hill and Dixon [39]. Being a pragmatic campaign, LL drew on theory, but did not set out to comprehensively test a single theoretical model [54]. The campaign rationale contended at-risk individuals will act to reduce body weight and maintain that reduction to the extent they are: 'motivated'—determined by the personal perceived and 'felt' threat of disease and the extent to which the benefits of weight reduction are seen to outweigh the costs [36], 'enabled'—belief one has the skills and ability necessary for behaviour change [34, 35] and 'reinforced'—characterized by the extent to which results are observable [53].

This paper reports evaluation of the first year of the LL campaign. The primary aim was to estimate the population-impact of LL on proximal outcomes (campaign recall and appraisal) and determine whether there were differences in these measures based on orientation of the message. Secondary aims were to estimate LL's population-level

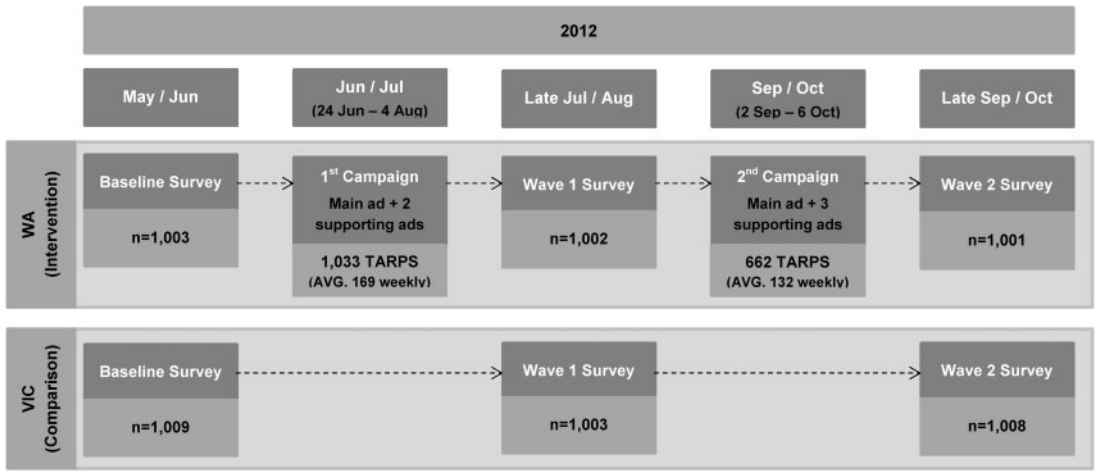

Fig. 1. LL campaign timeline and evaluation design.
Note: TARPs are a product of the percentage of the target audience exposed to an advertisement (reach) and the average number of times a target audience member would be exposed (frequency) [37]. Hence, 200 TARPs might represent 100% of the target audience receiving the message an average of two times over a specified period or 50% reached four times.

impact on intermediate indicators (attitudes, beliefs and intentions) and more distal outcomes (behaviour changes).

Materials and methods

Intervention

The principal (30 s) LL campaign ad graphically depicted extensive visceral 'toxic fat' around an overweight person's organs. To provide 'motivation' for change, the ad aimed to increase awareness and create new understanding of health consequences of overweight, together with exposure to physiological realities of overweight. This ad provided the 'why' change campaign message and was executed to engender interest, surprise and self-referent feelings such as alarm by convincing people they may be personally susceptible to the threat. Four supporting ads reminded viewers of this visceral imagery and provided 'how' to change messages, illustrating small achievable changes in activity and diet that can be made in the immediate-term to successfully avert the threat [55] (i.e. 'enablement'). Highlighting opportunities for immediate action was central to the campaign rationale, to provide positive 'self-reinforcement' to help relieve any alarm felt in response to the ad and condition weight control behaviours [53]. Campaigns that seek to reframe an issue as a public health problem and provide suggestions for resolution are less likely to prompt defensive responses than health threats alone [55]. LL advertisements were extensively pre-tested with formative, qualitative research among overweight and healthy weight adults [56].

LL was launched in Western Australia (WA) (population 2.5 million) [57] on 24 June 2012. Because of greater likelihood of weight gain between ages 25 and 64 [2] the campaign primarily targeted this age group. Figure 1 shows campaign dates, evaluation design and Target Audience Rating Points (TARPs), a media exposure measure indicating reach and frequency of campaign waves [58]. The principal ad was broadcast during both media waves, complemented by two different supporting ads (15 s) on diet and activity. An additional supporting ad at the second media wave depicted the campaign Website (www.livelighter.com.au), where the ads and supporting information could be accessed. Paid television advertising was complemented by paid cinema, radio, print

and online advertising. The campaign budget was comparable with those of commercial media campaigns. The advertising was part of a broader strategy aimed to generate community, media and political support, through media advocacy and stakeholder engagement, for policy and environmental changes supportive of healthy eating and physical activity.

Evaluation design and sample

To assess campaign impact, a pre-campaign cross-sectional survey was undertaken and repeated following each media wave in WA (intervention state) and Victoria (comparison state) (see Fig. 1). A random sample of 2012 (intervention $N = 1003$; comparison $N = 1009$) adults aged 25–49 were surveyed at baseline, and 2005 at wave 1 (W1) (intervention $N = 1002$; comparison $N = 1003$) and wave 2 (W2) (intervention $N = 1001$; comparison $N = 1008$). The sample sizes yielded a subsample of overweight adults {based on BMI [weight (kg)/height (m)^2] = 25+, using self-reported height and weight} [59] and parents (of at least one child under 18 years who resides with them) for analysis (largest 95% CI around an estimate of 50% is ±4.3%).

The evaluation was approved by Cancer Council Victoria's Human Research Ethics Committee. Random digit dialling drew from a sample frame of private household telephone landline numbers. The person who identified as the youngest male aged 25–49 (or youngest female if no males) in the household was selected for interview. At each survey, quotas of 45/55% for sex (male/female), 35/65% for age-group (25–34/35–49) and 70/30% for region (metropolitan/rural) were achieved in both states. Response rates were 35%, 40% and 44% across the respective surveys.

Measures

Given practical and financial constraints on survey length, the survey instrument was designed to parsimoniously assess those indicators predicted to be influenced by the LL campaign, rather than to test a complete theoretical model.

Intervention sample

Campaign recall. Measured by asking respondents to describe any television advertisements about being overweight they had seen in the past month and coding mentions of LL ads.

Recognition. Measured by prompting respondents with a brief description (principal ad: 'an overweight man eating pizza from the fridge'). Recall or recognition was summed to provide total awareness.

Perceived message effectiveness. Ratings of the campaign advertising were obtained in the post-campaign surveys (see Table II for wording), as such measures can predict health-related behaviour change [40–42, 60–65].

All respondents

Self-referent thoughts about weight and health. Respondents were asked how often they thought about the health-related harms of overweight (i.e. perceived susceptibility defined by the Health Belief Model [36]) and what they thought the impact of weight loss would be on their health.

Attitudes

Given attitudes and beliefs form the basis on which decisions to act are made [36], overweight respondents (BMI = 25+) were asked to rate the personal perceived urgency of weight loss on a 10-point Likert scale (0 = 'not at all', 5 = 'fairly', 10 = 'extremely'). Owing to positive skewness in the distribution, responses were dichotomized at the median (0–6 or 7–10) for analysis. Overweight respondents were also asked whether they thought the benefits of weight loss would outweigh the costs using a forced-choice categorical response scale.

Self-efficacy

Given belief that one has the skills and ability necessary for behaviour influences its occurrence, [34, 35] weight loss self-efficacy was rated by overweight respondents (BMI = 25+) on a 10-point Likert scale and dichotomized at the median as described above.

Intentions and behaviour

Intentions are thought to precede behaviour change [34]. Respondents were asked whether it was likely they would make specific dietary changes over the next 7 days. A composite scale combined ratings of 'slightly' or 'very' likely they would do two of the following in the next 7 days: (i) cut down the amount of high calorie foods you eat, (ii) drink fewer sugar-sweetened drinks, (iii) eat smaller portion sizes and (iv) eat more fruit and vegetables. Respondents were also asked the likelihood they would meet recommended physical activity levels in the following week; their current plans concerning weight loss; and whether they had taken any steps to try to lose weight in the last 7 days. Steps to weight loss include participants who reported at least one behaviour in the question: 'In the past 7 days, what steps, if any, have you taken to try to lose weight?'

Overweight stereotypes

To check for potential unintended effects of the campaign on weight-based stereotypes, respondents were asked whether they agreed or disagreed that overweight (cf. 'healthy' weight) people are more likely to (i) be happier, (ii) lack willpower, (iii) have fewer friends, (iv) be more outgoing and (v) have less energy. A composite scale combined ratings of 'agreed' for two or more of these stereotypes. They were also asked whether they agreed with two broader societal stereotypes. (See Table III for details of survey wording.)

Statistical analysis

Data were analysed using Stata SE 11.1 (StataCorp, Texas) during 2013 and weighted to the population on sex, age, place of residence [66] and educational attainment [67]. Chi-square analysis assessed whether demographic characteristics differed between states at each survey. Logistic regression analysis tested interactions by state (WA versus Victoria) and subsequent surveys (baseline versus W1; baseline versus W2) controlling for socio-economic status (SES) and BMI. Interactions were tested for the full sample and the sub-sample of overweight/obese respondents. Overweight/obese and healthy weight/underweight categories were combined and are referred to as 'overweight' and 'not overweight', respectively. Logistic regression was undertaken to determine whether campaign recall differed according to sex, age, BMI, parental status, place of residence and SES when controlling for all other factors and time spent viewing commercial television. Differences in ratings of perceived effectiveness by ad type (principal versus supplementary) were tested using logistic regression controlling for individual-level clustering and the above demographics.

Results

Respondent characteristics

Table I shows the samples surveyed in each state and study phase comprised similar distributions for all demographic characteristics except a greater proportion of WA than Victorian respondents were of high SES at baseline ($P < 0.05$) and at W2 ($P < 0.05$). Consequently all multivariate analyses controlled for SES.

Recall and total awareness of the LL campaign

Time-by-state comparisons indicated a strong effect of the campaign on unprompted recall of weight-related advertising [W1: $F(1, 3917) = 20.54$, $P < 0.001$; W2: $F(1, 3920) = 15.17$, $P < 0.001$]. In WA there was a significant increase from 36% to 55% and 48%, respectively, in the post-campaign surveys [W1: odds ratio (OR), 2.22, 1.77–2.79, $P < 0.001$; W2: OR = 1.69, 1.35–2.12, $P < 0.001$], whereas in Victoria the proportions remained stable across surveys at 29%, 29% and 26% (W1: OR = 1.02, 0.80–1.31, $P = 0.85$; W2: OR = 0.86, 0.67–1.11, $P = 0.25$). Around one-in-three adults recalled any LL ad and total campaign awareness was 54% at W1 and 50% at W2 (Fig. 2). Among overweight respondents total awareness was 58% at W1 and 53% at W2 (not shown in Fig. 2).

At W1, campaign recall was significantly greater among overweight adults (35% cf. 27%; OR =

Table I. *Demographic characteristics, by state and study phase*

	Western Australia			Victoria		
	Baseline (June) (%) (N = 1003)	W1 (August) (%) (N = 1002)	W2 (October) (%) (N = 1001)	Baseline (June) (%) (N = 1009)	W1 (August) (%) (N = 1003)	W2 (October) (%) (N = 1008)
Sex						
Male	45.1	44.8	45.0	45.3	44.9	44.6
Female	54.9	55.2	55.0	54.7	55.1	55.4
Age (years)						
25–34	34.9	34.8	34.7	35.1	35.0	35.7
35–44	40.4	41.1	38.1	38.9	40.6	36.3
45–49	24.7	24.1	27.3	26.1	24.4	28.0
Parent (child under 18)	57.5	60.1	53.5	60.8	58.2	52.3
BMI[a]						
Underweight	2.7	1.8	1.8	2.2	2.7	1.6
Healthy weight	41.8	45.7	44.8	43.1	44.1	44.3
Overweight	35.8	35.7	35.5	37.8	34.9	37.6
Obese	19.7	16.8	17.9	16.8	18.4	16.6
Place of residence						
Metropolitan	70.0	70.0	70.0	70.0	69.8	69.4
Rural	30.0	30.0	30.0	30.0	30.2	30.6
SES[b]						
Low SES	27.9	30.2	28.1	33.2	32.9	33.1
Mid SES	39.4	38.1	38.5	40.1	40.4	40.8
High SES	32.7*	31.7	33.4*	26.7*	26.6	26.1*
Completed secondary school	69.6	68.5	70.2	70.4	68.9	68.3
Aboriginal and/or Torres Strait Islander (ATSI)	1.6	0.9	0.8	0.8	0.4	1.3

Unweighted percentages. Percentages are rounded so may not sum to 100%.
[a]Weight status based on BMI [weight (kg)/height (m)^2] using self-reported height and weight classified into weight categories according to internationally recognized cutoffs [59].
[b]SES was determined according to the Index of Relative Socio-Economic Disadvantage (IRSD) rankings for Western Australia and Victoria as described by the Australian Bureau of Statistics [68, 69] based on respondent's home postcode. Low IRSD indicates greater disadvantage, high IRSD indicated least disadvantage. At baseline, no IRSD value was available for 21 respondents, 24 at W1 and 38 at W2.
*Significant difference at $P < 0.05$.

1.48, 1.03–2.14, $P = 0.03$). At W2, parents were more likely to recall LL (35% cf. 26%; OR = 1.59, 1.09–2.32, $P = 0.02$). Campaign recall did not significantly differ by sex or SES.

Perceived effectiveness of the LL campaign

Respondents who recognized at least one campaign ad (48% W1 and 43% W2) were asked to appraise it. Campaign ads were perceived by almost all adults who saw them as 'believable' and to have 'made a strong argument for reducing weight', with approximately half recognizing them as 'relevant to me' (see Table II). Respondents who saw the principal ad showed a higher likelihood of saying the ad 'made me stop and think' (OR = 1.65, 1.20–2.27, $P = 0.01$), 'taught me something new' (OR = 1.98, 1.48–2.65, $P < 0.001$), 'made a strong argument for reducing weight' (OR = 1.55, 1.01–2.37, $P = 0.04$), 'motivated me to take action to reach or stay a healthy weight' (OR = 1.49, 1.11–2.01, $P = 0.01$), 'made me feel uncomfortable' (OR = 2.63, 1.87–3.69, $P < 0.001$) and prompted discussion (OR = 1.72, 1.23–2.41, $P = 0.01$), compared with respondents who saw the supporting ads.

Table II. *Perceived effectiveness of LL in the intervention state*

	Overall (N = 685)	BMI: BMI < 25 (N = 287)	BMI: BMI 25+ (N = 383)
Principal ad[a]			
Was believable	95.5	95.6	95.2
Was relevant to me	55.7	36.6[b]	69.9**
Taught me something new	52.3*	49.7	55.3
Made me stop and think	75.8*	70.7[b]	78.9**
Made a strong argument for reducing weight	87.7*	88.6	86.8
Made me motivated to take action to reach or stay a healthy weight	65.3*	63.1	66.0
Made me feel uncomfortable	35.6*	33.9	37.2
Prompted me to discuss the ad	30.3*	30.3	31.0
Supporting ad(s)[c]	(N = 484)	(N = 197)	(N = 277)
Was believable	94.8	94.7	94.7
Was relevant to me	56.3	46.7[b]	62.6**
Taught me something new	36.2[b]	34.9	37.9
Made me stop and think	66.1[b]	56.9[b]	70.6**
Made a strong argument for reducing weight	80.3[b]	78.2	81.8
Made me motivated to take action to reach or stay a healthy weight	55.2[b]	56.5	54.2
Made me feel uncomfortable	17.1[b]	13.8	19.4
Prompted me to discuss the ad	18.8[b]	13.8	22.7

[a]Pooled responses to the principal ad in the first (Jun/Jul) and second media waves (Sept/Oct).
[b]Reference category.
[c]Pooled responses to the supporting ads shown in the first (Jun/Jul) and second media waves (Sept/Oct).
*Significant difference by ad type at $P < 0.05$ and
**BMI at $P < 0.05$.

Overweight adults were more likely to agree the principal and supporting ads were 'relevant to me' (OR = 4.23, 2.77–6.44, $P < 0.001$; OR = 1.92, 1.18–3.13, P = 0.01) and 'made me stop and think' (OR = 1.69, 1.06–2.68, P = 0.03; OR = 1.79, 1.08–2.98, P = 0.02).

Impact of the LL campaign on attitudes and behaviour

Table III shows adjusted proportions and Wald tests of interactions by state and study phase for baseline, W1 and W2 outcome measures. Significant results are described in-text. Compared with baseline, a greater proportion of WA adults reported thinking about the harms to their health of being or becoming overweight at W1 (OR = 1.32, 1.06–1.65, P = 0.01), whereas this difference was not seen in Victoria (OR = 0.95, 0.76–1.19, P = 0.68). The same pattern of results was found among overweight adults at W2 (WA: OR = 1.49, 1.07–2.07, P = 0.02; Victoria: OR = 0.90, 0.66–1.24, P = 0.53). The proportion of WA adults who reported they would likely meet physical activity recommendations in the immediate term increased significantly from baseline to W2 (OR = 1.89, 1.44–2.47, $P < 0.001$), whereas such an increase was not seen in Victoria (OR = 1.15, 0.88–1.50, P = 0.30). Interactions tested by state and study phase for weight loss attitudes and overweight stereotypes were not significant.

Discussion

LL campaign advertising in WA achieved strong penetration in a media environment containing much editorial, advertising and entertainment content on overweight. Gaining 'cut-through' is a necessary prerequisite for effective mass media

Table III. *Adjusted proportions and state by study phase interactions for attitudinal and behavioural measures*

	Overall sample							BMI 25+						
	Adjusted proportions							Adjusted proportions						
	WA			VIC			*F* (df)	WA			VIC			*F* (df)
	B	W1	W2	B	W1	W2		B	W1	W2	B	W1	W2	
N	973	968	981	986	975	966		540	509	524	539	519	523	
Awareness of the effect of weight status on health														
In the last 7 days, how often, if at all, did you think about the harms to your health of being or becoming overweight?	50.7	57.6	58.8	48.0	46.9	52.3	B cf. W1: $F(1, 3854) = 4.05$*; B cf. W2: $F(1, 3841) = 2.20$	62.5	71.0	71.3	61.8	61.8	59.4	B cf. W1: $F(1, 4949) = 3.30$; B cf. W2: $F(1, 4960) = 5.30$*
If you lost weight, do you think your health would: improve (a little or a lot)?	70.7	72.5	74.3	69.6	71.4	71.8	B cf. W1: $F(1, 3838) = 0.21$; B cf. W2: $F(1, 3827) = 0.67$	87.1	84.8	87.4	87.1	87.3	87.6	B cf. W1: $F(1, 4946) = 0.33$; B cf. W2: $F(1, 4958) = 0.01$
Weight loss attitudes[a]														
Thinking about the things you'd need to do to lose weight, do you think: the sacrifices would outweigh the benefits?								64.1	68.4	72.2	65.7	66.9	66.8	B cf. W1: $F(1, 2078) = 0.27$; B cf. W2: $F(1, 2091) = 1.81$
How confident are you that you could lose enough weight to achieve a healthy weight? (7–10)								60.5	64.2	66.9	60.9	61.4	63.1	B cf. W1: $F(1, 2041) = 0.46$; B cf. W2: $F(1, 2061) = 0.44$
How would you rate the urgency of your losing weight? (7–10)								30.1	30.9	31.0	30.1	30.3	31.9	B cf. W1: $F(1, 2065) = 0.02$; B cf. W2: $F(1, 2075) = 0.01$
Weight loss intentions & behaviours														
Intend to make dietary changes in the next 7 days[b]	59.6	60.2	66.9	52.7	60.4	65.0	B cf. W1: $F(1, 3859) = 2.28$; B cf. W2: $F(1, 3848) = 0.95$	66.5	63.6	69.2	61.4	62.7	68.4	B cf. W1: $F(1, 4950) = 0.50$; B cf. W2: $F(1, 4963) = 0.38$
Intend to do 30 min of moderate physical activity in the next 7 days	73.6	76.9	84.0	75.6	72.4	78.1	B cf. W1: $F(1, 3852) = 3.65$; B cf. W2: $F(1, 3843) = 3.91$*	74.0	77.1	84.0	75.3	73.9	78.4	B cf. W1: $F(1, 4946) = 0.75$; B cf. W2: $F(1, 4960) = 1.85$

(continued)

Table III. *Continued*

	Overall sample							BMI 25+						
	Adjusted proportions							Adjusted proportions						
	WA			VIC			F (df)	WA			VIC			F (df)
	B	W1	W2	B	W1	W2		B	W1	W2	B	W1	W2	
N	973	968	981	986	975	966		540	509	524	539	519	523	
Plan to lose weight within the next month	41.7	36.6	44.6	35.1	36.9	42.2	B cf. W1: $F(1, 2605) = 2.18$; B cf. W2: $F(1, 2660) = 1.05$	46.3	42.3	50.4	42.5	41.7	48.1	B cf. W1: $F(1, 4490) = 0.31$; B cf. W2: $F(1, 4530) = 0.09$
Taken steps to lose weight in the last 7 days[c]	54.5	50.8	51.4	42.7	45.0	46.8	B cf. W1: $F(1, 3196) = 1.78$; B cf. W2: $F(1, 3221) = 1.85$	66.0	61.4	59.8	51.5	56.5	53.8	B cf. W1: $F(1, 4725) = 2.67$; B cf. W2: $F(1, 4754) = 2.15$
Overweight stereotypes														
Individual stereotypes[d]	76.0	73.4	72.9	70.8	73.2	72.6	B cf. W1: $F(1, 3859) = 2.05$; B cf. W2: $F(1, 3848) = 2.39$	75.5	71.1	72.1	72.7	73.3	74.0	B cf. W1: $F(1, 4950) = 1.22$; B cf. W2: $F(1, 4963) = 1.36$
Nowadays an overweight person is more likely to be blamed for their health problems	87.2	85.6	87.1	86.3	84.5	83.8	B cf. W1: $F(1, 3823) = 0.03$; B cf. W2: $F(1, 3815) = 1.04$	86.9	86.4	87.6	89.7	86.4	83.1	B cf. W1: $F(1, 4929) = 0.84$; B cf. W2: $F(1, 4945) = 3.44$
Health authorities exaggerate the harmful effects of being overweight	18.2	18.0	13.2	19.6	16.4	16.5	B cf. W1: $F(1, 3831) = 0.49$; B cf. W2: $F(1, 3819) = 1.12$	21.2	19.7	13.1	21.0	16.1	18.2	B cf. W1: $F(1, 4937) = 0.51$; B cf. W2: $F(1, 4944) = 2.06$

B, Baseline Survey; W1, Survey wave 1; W2, Survey wave 2.
[a]Only asked of BMI 25+.
[b]Includes participants who reported it is 'slightly' or 'very' likely they would do two of the following in the next 7 days: (i) cut down the amount of high calorie foods you eat, (ii) drink fewer sugar-sweetened drinks, (iii) eat smaller portion sizes and (iv) eat more fruit and vegetables.
[c]Includes participants who reported at least one behaviour in response to: 'In the past 7 days, what steps, if any, have you taken to try to lose weight?'.
[d]Includes participants who 'agree' with two or more stereotypes: compared with healthy weight people, overweight people are more likely to (i) be happier, (ii) lack willpower, (iii) have fewer friends, (iv) be more outgoing, and (v) have less energy.
*Significant difference at $P < 0.05$.

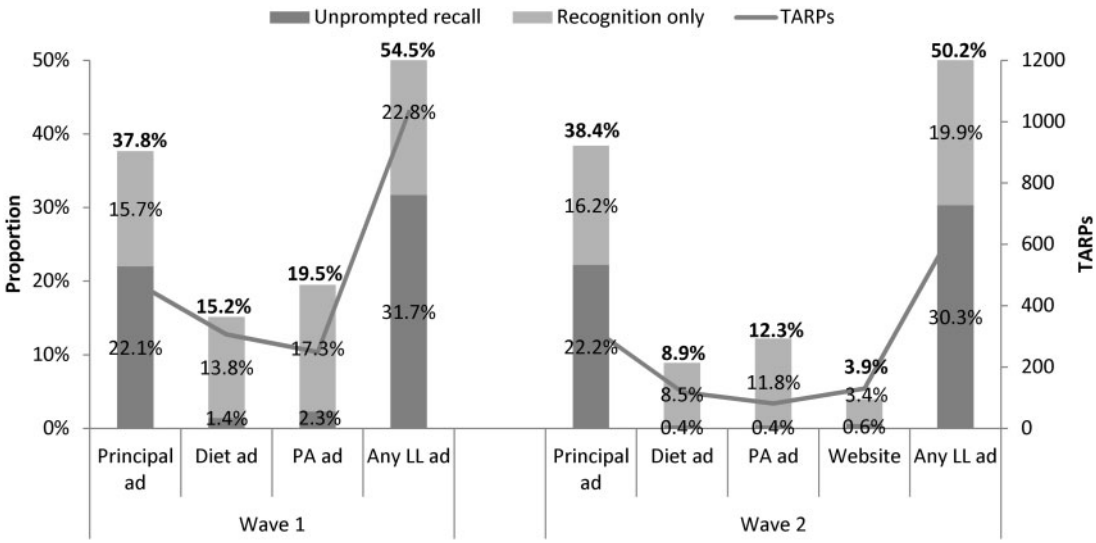

Fig. 2. Awareness of LL in the intervention state by TARPs.
Note: Any LL ad includes general mentions of toxic fat and figures are greater than the sum of the individual ads as more than one ad could be counted for a given respondent.

communication of health messages [70] and is a particular challenge for obesity prevention messages given the cluttered media environment. Campaign awareness was fairly stable across the two waves (54% and 50%) despite a reduction in total TARPs at W2 (1033 cf. 662). This population reach is comparable with that reported for other obesity prevention campaigns locally (49%) [16] and internationally (56%) [28].

That overweight adults were significantly more likely to recognize the self-relevance of the principal ad provides evidence LL reached and resonated with the target audience. This specificity distinguishes LL from other obesity prevention campaigns which found no difference in campaign awareness or self-relevance by BMI [22, 25, 71]. That parents were more likely to recall the campaign at W2 is encouraging as the association between parents' and children's body weight [72–74] is at least partly attributable to parental modelling and supervision [75, 76]. Some obesity prevention campaigns have been recalled more by women and higher SES respondents [16, 23, 24]. Notably, recall of LL was similar by gender and across SES.

The principal ad was more commonly recalled after each media wave than supporting ads and the difference was disproportionate to the level of TARPs. This suggests the 'why' message was more likely to reach respondents than the 'how' messages; a finding consistent with anti-smoking campaigns where use of graphic imagery to illustrate negative health effects of smoking ('why' messages) have been associated with higher recall and changes in attitudes, intentions and behaviours than 'how' messages [33, 43, 44]. As with anti-smoking advertisements, the LL campaign 'why' ad was perceived to have a more effective message than the 'how' ads. Such perceptions have been shown to predict subsequent quit intentions and positive changes in smoking behaviours in response to anti-smoking advertising [40–42]. A recent quantitative study comparing viewer's short-term reactions to various adult-targeted obesity prevention campaign ads found the principal LL ad outperformed others on message acceptance, argument strength, negative emotional impact and personalized perceived effectiveness [45]. These findings contrast with other research [77] which found consumers would prefer messages focussed

only on lifestyle change without mentioning body weight. LL took an unequivocal focus on overweight and obesity, backing this up with lifestyle recommendations.

The message of the LL campaign 'why' ad aimed to increase awareness of health consequences of overweight to 'motivate' lifestyle change [36]. Accordingly, in the intervention state following LL, thoughts about the harms to health of being overweight increased and overweight adults more commonly considered the threat of weight-related disease. The 'how' messages of the supporting ads aimed to 'enable' viewers to modify their lifestyle [34, 35] by demonstrating immediate and achievable changes that provide positive 'self-reinforcement' [53]. The importance of accompanying 'why' messages with 'how' messages to empower people to avert health threats has been illustrated [55]. Evidence LL enabled viewers to act is found in increased intentions to meet activity guidelines in the immediate term, which is encouraging given such intentions have been associated with weight loss and improved health in the longer-term [78]. LL's physical activity supporting ad was better recalled and recognized than the dietary supporting ad, despite marginally fewer TARPs for the former—consistent with activity intentions showing more evidence of movement than intentions to change dietary behaviour. Greater recall of physical activity messages than dietary change messages has been reported previously [79]. That an increase in intentions was not evident until W2, despite fewer TARPs for the preceding media wave, suggests the importance of continued reinforcement of the campaign messages over time and with continued investment, further change can be achieved.

As might be expected in the initial phases of a mass media campaign on obesity prevention, LL was not associated with any other changes in weight loss intentions or behaviour. It might be premature to conclude a campaign such as this is inherently incapable of causing behaviour change because a more likely explanation is measurement took place too early for behaviour change to register. LL is a relatively 'immature' campaign [70]. To be successful population campaigns require regular media activity over an extended period of time [7, 80, 81] in order to attempt to counter the significant environmental drivers precipitating and maintaining weight gain [82]. Campaigns addressing the complex behaviours antecedent to overweight reduction have commonly not shown direct and immediate impacts on behaviour at the population-level [10, 32, 83, 84] and behavioural effects are more likely to be reported in the longer-term [85]. The present findings would argue for continuing greater emphasis on the 'why' message to motivate change, ahead of the 'how' message that is useful to people who have become motivated to change. Overall, given awareness (health consequences) increased at W1 and increased intentions (physical activity) emerged at W2, findings support the underpinning of obesity prevention campaigns with a theoretical orientation that recognizes changes in attitudes and beliefs are necessary precursors to volitional behaviour change [34]. Findings also add to the existing body of literature which suggests sustained campaign activity is required to promote measurable behavioural impact [7, 33, 80, 81].

Some have suggested campaigns such as LL could unintentionally stigmatize overweight people [77, 86]. Pleasingly, endorsement of stereotypes of overweight individuals, a measure of the social component of stigma, did not increase after LL aired. Although overweight respondents were significantly more likely than healthy weight respondents to recognize the self-relevance of LL ads, this evaluation found they were no more likely to experience a negative emotional response to the ads. However, in a comparative ad rating study testing short-term reactions to ads, overweight adults did show stronger negative emotional reactions to the principal LL ad than healthy weight participants, as well as stronger perceptions of perceived effectiveness such as confidence and motivation in response to the ad [45]. Future longitudinal research should examine the extent to which negative emotional responses to obesity prevention advertising are tied with perceptions of advertising effectiveness and adaptive behavioural responses. The campaign did not affect perceptions that health authorities exaggerate health effects of

overweight, implying acceptance of the campaign message that overweight is associated with serious health issues, which could provide motivation for weight reduction.

Use of a pre–post-test comparison group evaluation design significantly enhances the strength of the evidence of campaign effects by allowing comparisons longitudinally in outcomes of interest in exposed and unexposed populations, controlling for most threats to internal validity [70, 79, 87]. Limitations include difference in history of exposure to nutrition, activity and obesity prevention campaigns in the two states [7, 13, 16, 19]. For example, this could have led to a greater effect of the campaign given the audience was primed to think about the issues addressed, or to the campaign having a lesser impact than a new message might for an audience not previously primed to think about their weight, diet or activity. It was not possible to control for potential confounders unrelated to the campaign that were unique to WA and may have affected weight-related intentions and behaviours. Reliance on self-report and risk of socially desirable responses are possible sources of bias, although seemingly unlikely to apply differentially to the intervention and comparison states.

Conclusions

LL achieved significant 'cut-through' amidst the cluttered field of mass media messages about overweight. Population awareness, which compares favourably with other obesity prevention campaigns, was maintained after W2 despite a reduced media buy. LL was more likely to be recalled by overweight adults who were consistently more likely to perceive the campaign was relevant to them, suggesting LL reached and resonated with the target audience. That the principal campaign ad was more likely than supporting ads to reach viewers and be rated favourably on measures of perceived message effectiveness, suggests the importance of inclusion of the 'why' change message alongside the 'how' to change message. Despite significant countervailing environmental forces, LL was associated with some population-level improvements in proximal and intermediate markers of campaign impact, and was not associated with an increase in negative stereotypes about overweight individuals. The sequence of these improvements supports the influence of mass media campaigns on crucial preceding attitudinal variables and the need for sustained media activity over time. Findings provide evidence to help inform planning and development of future public health campaigns addressing overweight.

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Conflict of interest statement

Five of the authors (Swanson, Szybiak, Shilton, Pratt & Slevin) are employees of the Heart Foundation (Western Australia) or Cancer Council Western Australia who were involved in the development and/or implementation of the 'LiveLighter' campaign.

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