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Does message framing affect intentions to improve diet and physical activity? A randomized study in UK adults

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ABSTRACT

Engaging in regular physical activity and a healthy diet, in line with World Health Organisation (WHO) recommendations, have robust benefits on physical and mental health. One way to influence behaviour change is by improving the effectiveness of health communication. This study of 190 participants explored the effectiveness of message framing and temporal focus on behavioural intention to increase physical activity and improve diet. In this cross-sectional between-subjects design, ANCOVAs were conducted to investigate the main effects of message frame, message focus and the interaction effects on behavioural intentions with respect to diet and PA. Furthermore, regression analyses were used to determine the predictors of behavioural intentions (including perceived stress and BMI). Previous research suggests that BMI moderates responses to gain-framed messages, while stress impairs impulse control and affects dietary choice, making them critical variables in understanding behaviour change. Therefore, BMI and stress are included in the study because both factors could influence health behaviours and the effectiveness of message framing. There were no significant main effects or two-way interactions for the frame of focus on intentions to be more physically active. However, there was a significant three-way interaction between temporal focus, message frame and stress, such that people with higher perceived stress had a greater intention to improve their diet when the message was gain-farmed and had a focus on short-term rather than long-term gains. Furthermore, BMI was a significant predictor of both diet and intentions to be more physically active. The findings highlight the need for more research on the potential efficacy of message framing in health communication for preventive behaviours.

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Health message framing; health communication; health behaviour change

Introduction

Overweight and obesity are major health and economic issues (World Health Organization [WHO], 2018, 2021). Obesity can be caused by excess calories and/or combined with a lack of PA or poor diet (NHSinform, 2023). Additionally, PA and

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dietary patterns are associated with high levels of stress, by increasing or decreasing the motivation to engage in PA or consume a poor diet (Stults-Kolehmainen & Sinha, 2014; Lippke et al., 2015; Tomiyama, 2019), thus contributing to mental health and well-being (O'Neil et al., 2014). Stress, accounting for over 17 million working days lost per year (Health and Safety Executive, 2021), is another growing public health and economic issue that has been linked to a range of negative physical and mental health outcomes (WHO, 2020a). Regular PA and a healthy diet are referred to as prevention behaviours as they are important for preventing the development of health conditions such as obesity and cardiovascular diseases (CVD), and mental health conditions such as stress (WHO, 2020a). The rising prevalence of obesity suggests prevention behaviours are becoming less common (WHO, 2021); therefore, despite several public health food recommendations (Public Health England [PHE], 2018) and PA guidelines (NHS, 2022), physical inactivity and excess calorie consumption remain major public health challenges (PHE, 2021). Consequently, it is essential to improve health communication to influence behaviour change.

One way to influence behaviour change and increase prevention behaviours is to improve the effectiveness of health communication through Message Framing Theory. This theory suggests that the effectiveness of a health message is influenced by: (a) the type of behaviour advocated and (b) the framing employed (Rothman et al., 2006). Message framing is a widely studied communication strategy in health behaviour research because it can influence decision-making and motivation by shaping how information is perceived (Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007). Compared to other behaviour change strategies, message framing is particularly relevant for public health interventions as it could be easily implemented in health campaigns, policy messaging and digital health communication. Additionally, prior research suggests that message framing effects may vary based on individual differences (e.g. BMI, stress), making it an important area for investigation to optimize the effectiveness of health messaging (Pavey & Churchill, 2014).

Health messages can emphasise the potential gains of engaging in a behaviour, or the potential losses of failing to engage in that behaviour. For example, a loss-framed message would say 'Research shows that having a poor diet and insufficient physical activity may increase your risk of developing cardiovascular disease'. However, a gain-framed message would say 'Research shows that living a healthy lifestyle by having a healthy diet, and sufficient physical activity may improve mental health and wellbeing'. With respect to health-related messages, gain-framed messages are shown to be more effective for encouraging behaviours that involve minimal risk (prevention behaviours), whereas loss-framed messages would be more effective for promoting behaviours that involve risk or uncertainty (detection behaviours) (Rothman & Salovey, 1997; Tversky & Kahneman, 1981). Although there seems to be empirical support for the effectiveness of gain-framed messages for PA (Cho et al., 2018; Gallagher & Updegraff, 2012; Latimer et al., 2010; Van't Riet et al., 2010), the effect on other prevention behaviours such as diet has yielded mixed findings (O'Keefe and Jensen, 2007; 2011; Gallagher & Updegraff, 2012). These conflicting findings suggest more research is needed to determine the best way to frame a message to increase prevention behaviours.

Health messages can also be tailored to emphasise immediate short-term consequences or long-term consequences, to assess how temporal health consequences may

influence behavioural intentions. For example, a short-term message would say 'By making changes to your lifestyle, you [lower/increase] the likelihood of having reduced stress, improved mood, and better sleep', whereas a long-term message would be 'By making changes to your lifestyle, you may [lower/increase] your risk of cardiovascular disease'. Prior research has yielded mixed evidence regarding the impact of temporal focus within the context of message framing (Bernstein et al., 2016; Mollen et al., 2017). Some studies indicate that gain-framed messages with short-term consequences lead to stronger intentions to quit smoking (Mollen et al., 2017) and reduce alcohol consumption (Gerend & Cullen, 2008). Conversely, a study on intentions to increase fruit intake found gain-framed messages with long-term consequences to be more persuasive (G.-J. de Bruijn & Budding, 2016). Thus, while there is support for temporal focus enhancing the effectiveness of gain-framed messages in preventive behaviours, these studies vary in design, sample populations and measured outcomes, which may limit generalisability to other contexts. For example, Mollen et al. (2017) focused on young, highly educated smokers with low nicotine dependence, rather than high-risk individuals, while G.-J. de Bruijn and Budding (2016) did not assess actual behaviour change or message processing. Similarly, Gerend and Cullen (2008) examined alcohol reduction but did not test whether their results apply to other health behaviours, highlighting the need for further research on the combined effects of temporal focus and message framing in diverse contexts.

Overall, it is necessary to examine how both message framing and temporal focus interact to influence health-related intentions, as previous research has yielded mixed results on their individual and combined effects. A factorial design (message frame: gain vs. loss, message focus: short-term vs. long-term consequences) was chosen to explore these factors systematically. By combining these elements, we aim to provide a clearer understanding of how their interaction shapes health-related decision-making, which is crucial for developing effective health communication strategies. Furthermore, this design allows for a more comprehensive exploration of the combined impact of message framing and temporal context on a range of behaviours related to general health and well-being, as suggested by previous studies (e.g. Gerend & Cullen, 2008; Mollen et al., 2017).

Moreover, there may be additional variables that influence the effectiveness of health messages. First, the higher Body Mass Index (BMI) is associated with higher levels of physical inactivity and unhealthy dietary patterns (Lippke et al. 2015; Horacek et al., 2018). This highlights a need for health policies and service-focused interventions designed to improve motivation towards PA and a healthy diet in overweight or obese individuals. Previous research has shown that a higher BMI is associated with stronger intentions to lose weight (Niederdeppe et al., 2013), improve diet (Smith et al., 2021) and increase PA (Plotnikoff et al., 2013). However, Lippke et al. (2015) found that a higher BMI was associated with lower PA intentions. Overall, current data on obesity-related health intentions are limited and inconclusive. Therefore, more research is needed to better understand the role of BMI and behavioural intentions relating to PA and diet, to target interventions, increase motivation and influence behaviour change (Lippke et al., 2009). Additionally, to enhance the effectiveness of health messages and promote behavior change, it is crucial to consider other factors that may influence message framing effects. For example, stress has been identified as a predictor of dietary behavior (Hill et al., 2022; Mouchacca et al., 2013), with evidence showing that it impairs impulse

control (Starcke & Brand, 2012), making it more difficult to maintain health-promoting behaviors. Given its potential influence on decision-making, perceived stress should also be accounted for in message framing studies to better understand its role in shaping behavioural intentions. Few studies have assessed the effects of stress on behavioral intentions (Louis et al., 2009; O'Connor et al., 2005). However, research indicates that perceived stress increases motivation towards snacking and consuming high-density foods (O'Connor, 2008; Louis et al., 2009) while decreasing physical activity (Stults-Kolehmainen & Sinha, 2014). This may be due to stress interfering with decision-making and intentions to engage in healthy behaviors. For instance, Starcke and Brand's (2012) review demonstrated that stress impairs cognitive control and executive functions. This suggests that reduced motivation to engage in healthy behaviors may result from the dysregulation of self-regulatory processes caused by stress.

On the other hand, stress plays a significant role in the Protection Motivation Model (Rogers, 1975) by enhancing the perception of threat and increasing motivation to engage in protective behaviors. Since stress impacts both threat appraisal and coping appraisal, it serves as a key factor in the decision-making process to adopt protective actions. Therefore, it is reasonable to assume that stress and intentions are closely associated (Norman and Conner, 1996). Understanding this relationship could help tailor interventions to improve motivation towards physical activity and healthier eating habits. Overall, it is crucial to enhance our understanding of health communication and the factors that may influence behaviour change.

Consequently, this study aims to address these limitations with two primary research questions:

(1) Are gain- or loss-framed messages more effective for influencing behavioural intentions to increase PA and improve diet?
(2) Are behavioural intentions driven by short-term (e.g. reduced stress) or long-term consequences (e.g. preventing the risk of CVD)?

Methods

Participants

One hundred and ninety participants (61 males; 126 females and 3 non-binary), aged between 18 and 77 years old ($M = 37.31$; $SD = 12.89$) (see Table 1) were invited to take part in an online questionnaire via the Prolific Academic website, and incentivized for participation. Ethical approval was granted by a University Ethics Committee. Results were reported in line with STROBE guidelines (Vol Elm, 2007).

Design

A 2 (message frame: gain vs. loss) by 2 (message focus: short-term vs. long-term consequences) between-participants design was used (see flow diagram presented in Figure 1). These messages are presented below, with the key manipulations to the text displayed in parenthesis. Notably, the messages were designed to broadly

Table 1. Demographic factors of the 190 participants.

Variable	N (%)	General population data (%)[1]
Gender		
Male	61 (31.9)	(49.3)
Female	126 (66.0)	(50.7)
Non-Binary	3 (1.6)	
Age M (SD), Range	37.31 (12.89), 18–77	49.77 (16.78)
BMI M (SD), Range	25.51 (6.87), 11–54	27.50 (6.17)
BMI ≥ 25	90 (47.5)	
BMI < 25	100 (52.5)	
Meet the DOH guidelines for physical activity?		
Achieve this every week	48 (25.1)	(58)
Almost there, but not quite	47 (24.6)	
Around half of recommended	48 (25.1)	
A long way off recommended	46 (24.1)	
Meet the DOH guidelines for a balanced diet?		
Achieve this every week	39 (20.4)	(27.6)
Almost there, but not quite	73 (38.2)	
Around half of recommended	49 (25.7)	
A long way off recommended	29 (15.2)	
Perceived Stress Scale (PSS)		–
Low stress	30 (15.8)	
Moderate stress	112 (58.9)	
High stress	48 (25.3)[c]	

Note: Due to a formatting error in the PSS questionnaire, the response option "fairly often" was split across two response options. However, during data analysis, we combined these responses into a single data point to maintain consistency with the original questionnaire.

[a]Office for National Statistics, (2022). Population estimates for UK, England and Wales, Scotland and Northern Ireland https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland.

[c]DOH = Department of Health.

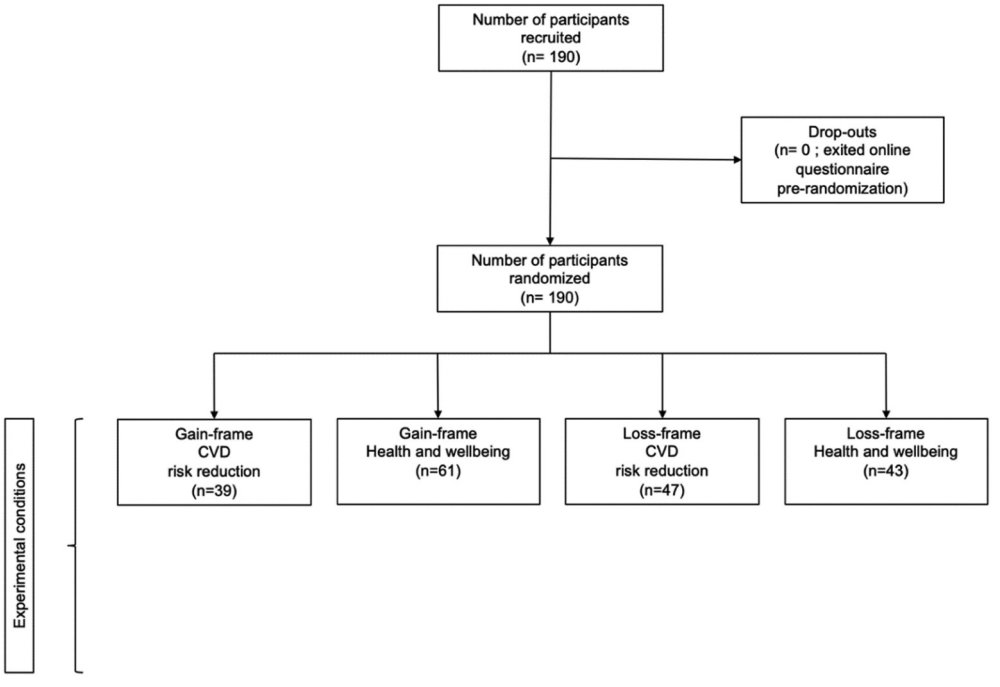

Figure 1. Study flow diagram.

promote general health and well-being, referencing additional behaviours beyond those measured in this study. These inclusions helped to create more comprehensive health messages.

Scenario 1: gain-frame long-term health consequence

Research shows that risk factors for cardiovascular disease include smoking, having a poor diet, having insufficient physical activity, drinking excessive amounts of alcohol and being overweight. By making changes to your lifestyle, you may [lower] your risk of cardiovascular disease.

Scenario 2: loss-frame long-term health consequence

Research shows that risk factors for cardiovascular disease include smoking, having a poor diet, having insufficient physical activity, drinking excessive amounts of alcohol and being overweight. By [not] making changes to your lifestyle, you may [increase] your risk of cardiovascular disease.

Scenario 3: gain-frame short-term health consequence

Research shows that living an unhealthy lifestyle such as smoking, having a poor diet, having insufficient physical activity and drinking excessive amounts of alcohol may not improve mental health and wellbeing. By making changes to your lifestyle, you [increase] the likelihood of having reduced stress, improved mood and better sleep.

Scenario 4: loss-frame short-term health consequence

Research shows that living an unhealthy lifestyle such as smoking, having a poor diet, having insufficient physical activity and drinking excessive amounts of alcohol may improve mental health and wellbeing. By [not] making changes to your lifestyle, you [reduce] the likelihood of having reduced stress, improved mood and better sleep.

Materials and procedure

Health messages were constructed in line with the World Health Organisation (2020b, 2020c), which contained information about the benefits of PA and a healthier diet. Prior to the study, participants followed an online link to the questionnaire, which contained the participant information sheet and consent form. Afterward, participants provided demographic information and self-reported their current physical activity and dietary habits, specifying whether they met the weekly recommendations outlined in shown government public health guidelines for a balanced diet and the intensity and frequency of physical activity. Participants were then randomly allocated to read one of the four health messages, after which they answered the post-message questionnaire to assess behavioural intentions with respect to PA and diet. This methodology enabled experimental control to identify the most effective message influencing behavioural intentions (G. J. de Bruijn et al., 2014; Rosenblatt et al., 2019). The messages are presented in Supplementary file A, with the key manipulations to the text displayed in parenthesis.

BMI and perceived stress were used as predictor variables. BMI was calculated using self-reported measures of height (in centimetres) and weight (in kilogrammes). Perceived

stress was measured using the 10-item Perceived Stress Scale (PSS-10, Cohen et al. 1983). This was measured on a 5-point Likert scale (0 [never]–4 [very often], possible range 0–40). Four of the ten items were reverse scored to match the direction of the other items (items 4, 5, 7 and 8). The responses were then added together to produce a psychological stress score, indicating the psychological stress scores (0–15 [low stress], 14–26 [moderate stress], 27–40 [high stress]).

Measures

Behavioural intention to increase physical activity and improve diet were the primary outcomes. These were measured on a 7-point Likert scale (1 [strongly disagree]–7 [strongly agree]), possible range (3–21) adapted from Keyworth et al. (2018) in line with published recommendations (Ajzen, 1991; Francis et al., 2004). Three items were used: (1) 'I expect to do more physical activity in the next month'; (2) 'I want to do more physical activity in the next month'; (3) 'I intend to do more physical activity in the next month'. The same items were adapted for improving diet. Behavioural intentions for each behaviour were calculated independently by totalling the scores of these three questions to form a new measure 'behavioural intentions' (scores ranging from 3 to 21).

Sample size and power calculations

The following is based on a previous study (Keyworth et al., 2018). Therefore, this study required a minimum of 160 participants (80 per main effect) to identify a standardised difference of 0.5 between the two groups (message frame and message focus), each of which was determined by a single main effect. Therefore, with a total of 190 participants, this study achieved more than 80% power to detect differences.

Analysis

To address objective 1, a series of two 2 by 2 analysis of covariance tests (ANCOVAs) were conducted to investigate the main effects of message frame, message focus and the interaction effects on behavioural intentions with respect to diet and PA. Perceived stress and BMI were added as covariates. Any significant interaction between message frame, message focus and BMI and perceived stress, respectively, were verified using one-way ANOVAs. To address objective 2, hierarchical multiple regression analyses were used to determine the predictors of behavioural intentions (including perceived stress and BMI). Effect sizes were calculated using the means and SDs of each experimental group. SPSS v26 was used to conduct the analyses.

At step one, demographic variables (age and sex) were added to test whether these contributed to changes in behavioural intentions. At step two, message frame (gain vs. loss), message focus (short-term vs. long-term consequences) and the frame × focus interaction term were added to test for any effect of the wording of health messages on behavioural intentions. At step three, perceived stress was added, followed by the addition of BMI in step four. The proportion of the variance in behavioural intentions predicted by the independent variables was measured by the adjusted multiple

Table 2. Descriptive statistics for each condition on behavioural intention scores.

	M (SD)					
	Gain-Frame			Loss-Frame		
Behavioural intentions	Short-term (*n*= 61)	Long-term (*n*= 39)	Overall	Short-term (*n*= 43)	Long-term (*n*= 47)	Overall
Physical activity	15.87 (3.79)	15.79 (4.27)	15.94 (3.96)	15.14 (3.61)	16.70 (3.28)	15.96 (3.51)
Diet	14.48 (4.27)	15.18 (4.94)	14.76 (4.54)	14.44 (4.43)	15.13 (4.14)	14.80 (4.27)

correlations (R^2), and the amount of variance explained by each step of the model was indicated by changes in the adjusted R^2.

Results

The success of the randomisation procedure was checked using MANOVA. The independent variable was *message* type with four levels (gain-frame short-term, gain-frame long-term, loss-frame short-term and loss-frame long-term). The dependent variables were age, gender and BMI. The multivariate test, $F(3,184) = 0.60$, $p = .80$, $\eta p\ 2 = .01$, and all the univariate tests, $Fs(3, 190) = 0.07$ to 0.89, $ps > .45$, $\eta p\ 2s < .02$, were nonsignificant, indicating successful randomisation.

The total sample ($n = 190$) was predominantly female (66%) (see Table 1 for a full breakdown of participant demographics). Demographics were compared to values from the general population (Office for National Statistics, 2022). The sample had a higher percentage of participants who were in the overweight or obese category (47.5%). However, the average BMI was lower (25.51) compared to the general population average (27.50). Additionally, most participants reported moderate levels of perceived stress. Descriptive statistics are shown in Table 2. Data are presented for independent variables (message frame and message focus) and dependent variables (intentions to increase PA and improve diet). The data shows that for behaviour intentions to increase PA, the condition loss-frame long-term had the highest scores. However, the gain-frame long-term condition had the highest behavioural intention scores to improve diet.

Physical activity behavioural intentions

The impact of the message frame and message focus on behavioural intentions to increase physical activity is presented in Table 3. A two-way ANCOVA was conducted to analyse the effects of message frame, message focus and interaction effects on total behavioural intention scores. With respect to both BMI and perceived stress as covariates, ANCOVA revealed no effects of frame, focus, or interactions, on intentions to increase physical activity.

Diet behavioural intentions

The impact of the message frame and message focus on behavioural intentions to improve diet is presented in Table 3. A two-way ANCOVA was conducted to analyse the effects of message frame, message focus and interaction effects on total

Table 3. Results of ANCOVA examining effects of message frame and message focus on physical activity and diet behavioural intentions (with perceived stress and BMI as covariates).

	df	*F*	*p*	Partial n^2
Diet				
Message frame	1	2.165	.143	.012
Message focus	1	1.976	.162	.011
Message frame x message focus	1	1.041	.309	.006
Frame x focus x perceived stress	4	4.131	.003	.083
Total	190			
Physical Activity				
Message frame	1	.245	.621	.001
Message focus	1	2.479	.117	.013
Message frame x message focus interaction	1	.191	.662	.001
Frame x focus x perceived stress	4	1.048	.384	.023
Total	190			
Diet				
Message frame	1	.143	.706	.001
Message focus	1	.798	.373	.004
Message frame x message focus	1	.299	.585	.002
Frame x focus x BMI	4	1.931	.107	.041
Total	190			
Physical Activity				
Message frame	1	.042	.837	.000
Message focus	1	.547	.461	.003
Message frame x message focus interaction	1	2.311	.130	.013
Frame x focus x BMI	4	2.003	.096	.042
Total	190			

Table 4. Post-hoc comparison of the main effects (according to high versus low perceived stress, and experimental condition).

Comparison					95% CI for difference	
Group	Group	Mean Difference	SE	Sig	Lower bound	Upper bound
Low PSS GFST	High PSS GFST	−3.939	1.081	.008	−7.25	−.62
Low PSS GFLT	High PSS GFLT	−3.000	1.381	.373	−7.23	1.23
Low PSS LFST	High PSS LFST	−2.382	1.308	.607	−6.39	1.63
Low PSS LFLT	High PSS LFLT	−1.951	1.273	.789	−5.86	1.95

behavioural intention scores. With respect to BMI as a covariate, ANCOVA revealed no effects of frame, focus, or interactions, on intentions to improve diet. However, with respect to perceived stress as a covariate, there was a significant interaction between message frame, message focus and perceived stress on intentions to improve diet [$F(4,190) = 4.1$, p=.003]. A one-way ANOVA for group (low versus high levels of perceived stress according to group [GFST, GFLT, LFST, LFLT]) revealed statistically significant differences between groups [$F(7,189) = 3.56$, $p < .01$] for intentions to improve diet with an effect size of $\eta^2 = .12$. Post-hoc comparisons employing the Tukey HSD revealed that intentions to improve diet were significantly higher in the high perceived stress gain-frame short-term condition compared to the low perceived stress gain-frame short-term condition ($p < .001$; post-hoc comparisons are presented in Table 4). The mean differences for intention scores are presented in Table 4, and differences between low and high perceived stress groups within the gain-frame short-term message condition illustrated using the violin plot presented in Figure 2 (additional violin plots for non-significant comparisons are presented in supplementary file B).

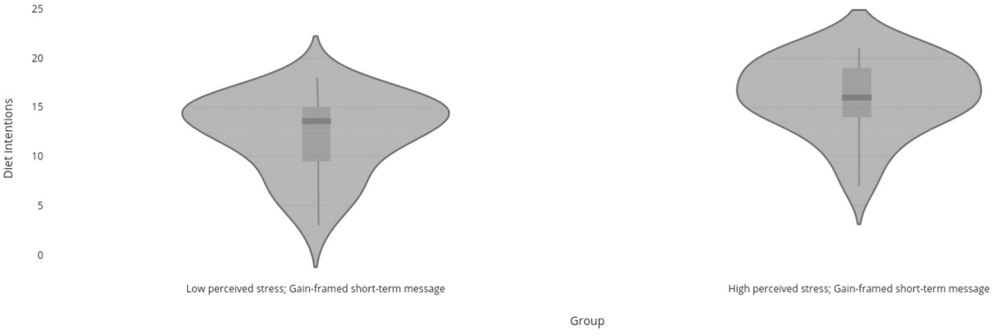

Figure 2. Violin plots showing the distribution of diet intention scores across the low and high-perceived stress groups within the gain-frame short-term message condition.

Table 5. Regression Model for physical activity behavioural intentions (n = 190).

Model		R^2	ΔR^2	β	95%CI	*p*-value
1		.018	.007			
	Gender[a]			.058	−.655 to 1.531	.430
	Age			−.113	−.075 to .009	.122
2		.028	.007			
	Gender			.069	−.575 to 1.627	.347
	Age			−.110	−0.74 to 0.10	.136
	Message frame			−.006	−1.127 to 1.037	.935
	Message focus			−.101	−1.848 to .336	.174
	Frame x Focus			−.070	−1.782 to .778	.321
3		.182	.033			
	Gender			.053	−.727 to 1.530	.484
	Age			−.087	−.069 to .019	.259
	Message frame			−.011	−1.163 to 1.005	.886
	Message focus			−.096	−1.815 to .373	.195
	Frame x Focus			−.065	−1.563 to .789	.175
	Perceived stress			.079	−.038 to .116	.317
4		.065	.034			
	Gender			.049	−.743 to 1.483	.513
	Age			−.101	−.073 to .014	.184
	Message frame			−.022	−1.235 to 1.483	.513
	Message focus			−.108	−1.892 to .270	.141
	Frame x Focus			−.056	−1.522 to .821	.121
	Perceived stress			.065	−.044 to .109	.405
	BMI			.180	.018 to .155	.014*

Note. *$p < .05$.
[a]Male = 1, Female = 2.

Multiple regression analyses: physical activity

Table 5 shows the hierarchical multiple regression model for physical activity behavioural intentions. It shows that in step 1, neither gender nor age weres independent predictors of behavioural intentions. At step 2, no additional variance was explained by the addition of message frame, message focus, or frame × focus, indicating that none of these factors accounted for variance in behavioural intentions. In step 3, the addition of perceived stress explained no additional variance. In the final regression model (step 4), BMI was added to the R^2 value of .065 showed that BMI positively predicted behavioural intentions ($\beta = .180$, $p < .05$), indicating participants who had higher BMI scores reported higher intentions to increase physical activity.

Table 6. Regression model for diet behavioural intentions (n = 190).

Model		R^2	ΔR^2	β	95%CI	p-value
1		.088	.078			
	Gender[a]			.177	.343 to 2.819	.013*
	Age			−.220	−.123 to −.028	.002*
2		.096	.076			
	Gender			.188	.427 to 2.922	.009*
	Age			−.217	−.121 to −.026	.002*
	Message frame			−.002	−1.240 to 1.212	.982
	Message focus			−.092	−2.048 to .426	.197
	Frame x Focus			−.053	−2.673 to 2.261	.460
3		.113	.088			
	Gender			.158	.135 to 2.679	.030*
	Age			−.178	−.110 to −.011	.016*
	Message frame			−.009	−1.302 to 1.138	.895
	Message focus			−.084	−1.968 to .494	.239
	Frame x Focus			−.076	−.756 to .691	.578
	Perceived stress			.139	−.002 to .172	.055
4		.138	.110			
	Gender			.154	.116 to 2.631	.032*
	Age			−.190	−.114 to −.016	.009*
	Message frame			−.019	.116 to 2.631	.781
	Message focus			−.094	−1.379 to 1.038	.180
	Frame x Focus			−.057	−1.657 to 1.127	.638
	Perceived stress			.127	−.008 to .164	.077
	BMI			.161	.013 to .168	.023*

Note. *$p < .05$.
[a]Male = 1, Female = 2.

Multiple regression analyses: diet

Table 6 shows the hierarchical multiple regression model for behavioural intentions to improve diet. It shows that in step 1, both gender (β = .177, $p < .05$) and age (β = −0.220, $p < .05$) were independent predictors of intentions to improve diet, indicating that females reported higher behavioural intentions and older participants reported higher behavioural intentions. In step 2, no additional variance was explained by the addition of message frame, message focus, or frame × focus. Both gender (β = .188, $p < .05$) and age (β = −.217, $p < .05$) remained significant but accounted for no additional variance. In step 3, the addition of perceived stress explained no additional variance. In the final regression model (step 4) BMI was added to the R^2 value of .138 revealing that BMI positively predicted intentions to improve diet (β = .161, $p < 0.5$) and explained 13.8% of the variance. Indicating participants who had higher BMI scores reported higher intentions to improve their diet.

Discussion

The primary aim of this study was to examine whether gain- or loss-framed risk messages were more effective at influencing behavioural intentions to increase PA and improve diet. Contrary to previous findings (Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007, 2009; Van't Riet et al. 2016), we found no effects of message framing or message focus on intentions to increase PA. The secondary aim of this study was to explore whether people's behavioural intentions were driven by the temporal focus of the health message. Although this study did not find a main effect for message focus nor an

interaction between message frame and message focus for PA intentions, we found a significant three-way interaction with gain-framed short-term messages and high perceived stress resulting in stronger intentions to improve diet. Lastly, this study aimed to explore the role of BMI and perceived stress on behavioural intentions, finding that a higher BMI (but not perceived stress) was associated with higher intentions to be more physically active and improve diet.

There may be several theoretical explanations for some of the null findings observed in our study. First, an individual's perception of the risk involved in engaging in a health behavior may influence the effectiveness of the message for promoting health behavior change. This suggests a role for exploring other mediating factors, such as perceptions of risk, which may influence the effects of message framing (Broemer, 2004; Covey, 2014; O'Connor et al., 2005; Van't Riet et al., 2016). Second, emotional responses to the health message may have impacted on message effectiveness. Research suggests that people may reject potentially threatening health messages and subsequently continue to engage in risky or unhealthy behaviours (Sherman & Cohen, 2006). This is in line with 'cognitive dissonance' theory, whereby people may reject health information that potentially contradicts their previous beliefs or behaviours (Festinger, 1957). In our study, some participants may have felt particularly at risk of certain health outcomes. For instance, as 79.5% of the participants did not meet recommendations for a healthy diet, and 74.6% did not meet recommendations for PA, this suggests a heightened risk of developing negative health outcomes for some of these participants, which may have resulted in weak processing of the message, thus limiting the ability to find a framing effect.

However, our findings align with prior research, demonstrating that stress can confer a significant gain-framed advantage. For example, Yamakawa et al. (2016) demonstrated elevated cortisol levels were associated with increased risk-avoidance intentions, suggesting a potential impact of stress on decision-making. Furthermore, Rizer et al. (2016) found among students that perceived stress resulted in stronger intentions to carry out mindfulness practices when there were perceived benefits rather than threats to future health problems, suggesting health promotion messages are more effective for risk-avoidance intentions under conditions of high perceived stress and immediate health outcomes. Additionally, as research shows that perceived stress results in increased motivation towards snacking and high-density food consumption (O'Connor, 2008; Louis et al., 2009), our study highlights how message framing and focus could play a crucial role in shaping individuals' dietary choices under stress. Understanding these dynamics can inform interventions aimed at promoting healthier eating behaviours during perceived stress, however more research is needed to confirm the effects of the interaction between message framing, temporal focus and perceived stress on diet behavioural intentions.

Additionally, this study found a higher BMI significantly predicted stronger intentions to increase PA and improve their diet, consistent with previous findings (Bastin et al., 2019; Chevance et al., 2017). However, although a higher BMI is associated with stronger intentions towards health behaviour change, those individuals are also less likely to meet physical activity and diet recommendations (Fan & Jin, 2014; Lippke et al., 2015). A possible explanation could be due to a higher BMI being associated with lower levels of perceived behavioural control (PBC) (Fan & Jin, 2014), which is a predictor variable of behavioural intentions in the Theory of

Planned Behaviour model (TPB) model (Ajzen, 1991). However, as these results are inconclusive (Jackson et al., 2013; Plotnikoff et al., 2013), there is a need for further research.

Furthermore, our study found that demographic variables may be important predictors for intentions to improve PA and diet. Our findings suggest that younger age is associated with higher intentions to improve diet, in line with previous studies (Laska et al., 2018). Additionally, this study found gender to be another significant predictor of dietary intentions, with females having significantly stronger intentions than males (Papadaki et al., 2015). This highlights the need for interventions to develop effective treatments to encourage healthy eating, specifically among males and older age groups.

Limitations and recommendations for future research

The results should be viewed in light of methodological limitations. Firstly, as the lack of a controlled environment could have resulted in distractions and less attention paid to the health messages compared to in a lab-based setting (Birnbaum, 2004). Secondly, this study was cross-sectional, and as message framing effects can develop over time (Latimer et al., 2008; Mikels et al., 2021), future studies should adopt a longitudinal research design with multiple exposures and follow-up measures. Additionally, our sample was less representative of the general population, with fewer participants having a BMI above 25 (47% vs. 64%) and a higher proportion of females (66% vs. 50.7%) (Office for National Statistics, 2022), indicating limitations due to opportunistic sampling. To enhance generalizability, future studies may consider using stratified sampling methods. Lastly, while research, such as Niederdeppe et al. (2013), has found significant effects on behavioural intentions when diet and physical activity are included in a single message, incorporating multiple health behaviours may have introduced inconsistencies in the intended behavioural outcomes.

Conclusion

Overall, this study found no effects of message framing on intentions to be more physically active or improve diet. However, we believe this study contributes to the message framing literature by highlighting a significant interaction between framing, temporal focus and stress – an area that has been largely overlooked in the previous research. While prior studies suggest that stress influences decision-making and health behaviours (Yamakawa et al., 2016; Rizer et al., 2016), our findings extend this work by demonstrating how message framing and temporal focus interact with stress to shape behavioural intentions. Given that perceived stress has been linked to increased risk-avoidance tendencies and specific dietary behaviours (O'Connor, 2008; Louis et al., 2009), our study underscores the importance of considering stress as a moderating factor in message framing research. These findings provide a foundation for future studies to further explore the mechanisms underlying this interaction and its implications for designing effective health interventions. Moreover, as framing effects seem to be more evident over long-term, future studies should adopt a longitudinal approach with follow-up measures of behavioural intentions.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical statement

Ethical approval was granted by a University Ethics Committee (PSYC-639).

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