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1 **The impact of nutritional labels and socioeconomic status on energy intake: an**
2 **experimental field study.**

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Abstract

There is some evidence for paradoxical effects of nutritional labelling on energy intake particularly amongst restrained eaters and those with a higher body mass index (BMI) resulting in greater consumption of energy from foods with a positive health message (e.g. “low-fat”) compared to the same foods, unlabelled. This study aimed to investigate, in a UK general population sample, the likelihood of paradoxical effects of nutritional labelling on energy intake. Participants (n=287) attended a London cinema and were offered a large tub of salted or toffee popcorn. Participants were randomised to receive their selected flavour with one of three labels: a green low-fat label, a red high-fat label or no label. Participants watched two film clips while completing measures of demographic characteristics, emotional state and taste of the popcorn. Following the experiment, popcorn consumption was measured. There were no main effects of nutritional labelling on consumption. Contrary to predictions neither BMI nor weight concern moderated the effect of label on consumption. There was a 3-way interaction between low-fat label, weight concern and socioeconomic status (SES) such that weight-concerned participants of higher SES who saw a low-fat label consumed more than weight unconcerned participants of similar SES ($t=-2.7, p=.04$). By contrast, weight-concerned participants of lower SES seeing either type of label, consumed less than those seeing no label ($t=-2.04, p=.04$). Nutritional labelling may have different effects in different socioeconomic groups. Further studies are required to understand fully the possible contribution of food labelling to health inequalities.

Keywords: nutritional labelling, consumption, socioeconomic status, weight concern.

1 **Background**

2 The ready availability of cheaply priced ready-prepared foods contributes to increased
3 consumption of energy-dense, nutrient-poor foods and the rise in preventable disease
4 including obesity, cardiovascular disease, Type 2 diabetes and various cancers. One of the
5 challenges that consumers face, even when motivated to eat more healthily, is that the
6 nutritional composition of these manufactured foods may not be immediately evident.
7 There is growing interest in packaging and labelling such foods more clearly in terms of
8 nutritional value to promote healthier food choices. The impact of a very wide range of
9 labelling schemes providing information about aspects of the nutritional content or health
10 effects of a food have been researched. For the purposes of this paper a nutritional label is
11 considered to be information given about at least one nutrient or energy in a relative (e.g.
12 “low”) or absolute (e.g. “2 grams”) amount format where the information is visible at the
13 point at which choices about what is to be consumed are made (Crockett, Hollands, Jebb, &
14 Marteau 2011).

15 Research has assessed the impact of various nutritional labelling schemes on a variety of
16 intended and behavioural outcomes across different populations. However neither the
17 overall effects of nutritional labelling in promoting healthier eating, nor the identification of
18 which of many labelling schemes are most effective, have been established. In assessing the
19 impact of nutritional labelling in assisting people towards eating more healthily a key
20 consideration is the impact of nutritional labelling on food consumption behaviour. Currently
21 the evidence on the effectiveness of nutritional labelling in achieving healthier consumption
22 behaviour is limited and with mixed evidence regarding the direction of effect. When
23 consumption following exposure to a nutritional label has been objectively measured,
24 overall consumption has been found sometimes to decrease (Roberto, Larsen, Agnew, Baik,
25 & Brownell, 2010; Temple, Johnson, Recupero, & Suders, 2010) and, paradoxically,
26 sometimes to increase, at least in samples recruited from University campuses (Aaron,
27 Evans, & Mela, 1995, Wansink and Chandon 2006, McCann, Wallace, Robson, Rennie,
28 McCaffrey, Welch, & Livingstone, 2013). These effects have been found across a range of
29 labelling formats including labelling of absolute amounts of energy and nutrients contained
30 in the product (Aaron, Evans, & Mela, 1995, McCann 2013), labelling indicating whether a
31 product is high or low in nutrients such as fat (Wansink and Chandon 2006), and labelling

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1 indicating that the food is more or less healthy (Temple et al. 2011). Paradoxical effects of
2 nutritional labelling have been found to be moderated by a number of participant
3 characteristics, with greater consumption observed in males (Aaron, Evans, & Mela, 1995,
4 McCann et al. 2013) those who are restrained eaters (Miller, Castellanos, Shide, Peters, &
5 Rolls, 1998) and those who are more overweight (Wansink and Chandon 2006). However,
6 these moderating effects are not consistently found with contrasting evidence suggesting no
7 moderating effects of BMI (Temple, et al., 2011) on consumption of products where a label
8 indicated that food items were either a more or less healthy choice.

9 Most of the research exploring the impact of nutritional labelling on consumption has been
10 conducted with university students, staff and families who represent groups that are well
11 educated and low in material and social deprivation. There has been very little research
12 exploring the impact of nutritional labelling on consumption across different socioeconomic
13 (SES) groups. One study found that self-reported use of nutritional labelling decreased with
14 lower education and income and that label use was positively associated with healthier
15 consumption, as assessed by 24 hour recall of food consumption (Ollberding, Wolf, &
16 Contento, 2010). To our knowledge there has been no research assessing paradoxical effects
17 of nutritional labelling in groups with lower SES. As these groups have higher rates of
18 overweight and obesity and diseases associated with being overweight (Bachmann, et al.,
19 2003; Coleman, et al., 2004; Foresight, 2007; Heraclides, Witte, & Brunner, 2008) it is
20 particularly important to know the impact of nutritional labelling in this group. Thus an
21 exploration of the impact of nutritional labels in general populations, including those of
22 lower SES, is warranted.

23

24 The current study seeks to investigate further the effects of nutritional labelling on
25 consumption by testing the impact of the presentation of a green “low fat” label, a red “high
26 fat” label or no label on a snack package. The expected main effect of labelling on
27 consumption is equivocal. However, following the findings of Roberto et al. (2010) and
28 Temple et al. (2010), we tested the following as Hypothesis I:

- 29 i. a low fat label is associated with greater consumption of the labelled product
- 30 ii. a high fat label is associated with lower consumption of the labelled product.

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1 Hypothesis II predicts that the effect of label on consumption is moderated by BMI and
2 weight concern such that higher BMI or weight concern result in

3 i. greatest consumption of the labelled product in those seeing a “low fat” label

4 ii. least consumption of the labelled product in those seeing a “high fat” label.

5

6 Additionally, given the associations between lower SES and diet-related disease, it was
7 considered important to explore the impact of SES on the relationship between a nutritional
8 label and consumption and its moderators. However, the limited research in this area
9 precluded the credible formulation of an *a priori* hypothesis and thus the following research
10 question was addressed:

11 What are the modifying effects of SES and

12 i. overweight

13 ii. weight concern

14 on the relationship between nutritional label and consumption?

15 These hypotheses and research question are tested in an experimental field study of the
16 impact of nutritional labelling on objectively assessed snack food consumption in a general
17 population sample of mixed SES.

18

Method

19 *Study design*

20 An experimental design with participants randomised to one of three groups to receive a
21 snack with no nutritional label, a green “low fat” or a red “high fat” label.

22

23 *Participants and recruitment*

24 Participants were recruited in streets surrounding a cinema in Streatham in South London in
25 the United Kingdom, an area with mixed SES, where the study was conducted. The only
26 inclusion criterion was that participants were over 18 years of age. Recruitment was
27 conducted by a research agency on the day of each of the experimental sessions.

28 Interviewers approached potential participants and asked if they would be interested in
29 participating in the study. Possible selection bias was minimised by providing interviewers
30 with minimal information about the study (i.e. just general information about the study with

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1 no reference to study hypotheses) and instructing them to approach all who passed by.
2 Those who expressed an interest were given more information about the study and
3 screened to assess eligibility. Any individual over 18 years of age, and willing to participate
4 was asked to sign a consent form and given a time to participate in the study.

5

6 *Sample size*

7 The program *G Power* (Heinrich Heine University) was used to calculate the sample size
8 required. Previous research suggested a medium effect of label on consumption (Wansink &
9 Chandon, 2006). However, given that the current study aimed to recruit a more
10 heterogeneous general population sample, we conservatively estimated a small to medium
11 effect of labels on consumption. Thus a sample of 266 participants gives 80% power to
12 detect a main effect of $f=0.20$ (medium) with significance of 0.05. The same sample size
13 gives 90% power, at the 5% level of significance to detect a small to medium effect ($f=.08$) of
14 a 3-way interaction (comprising 10 predictors) on consumption.

15

16 *Study materials*

17 The “low fat” and “high fat” labels were informed by the use UK Food Standards Agency
18 Traffic Light labelling scheme. Specifically the “low fat” label was coloured green and the
19 “high fat” label coloured red.

20

21 *Ethics Approval*

22 This study received approval from the King’s College London Research Ethics Committee
23 (PNM/09/10-121). As consumption is a behaviour that changes with the awareness of
24 observation, participants were told that the study was concerned with the impact of taste on
25 emotion and no mention was made that popcorn consumption would be assessed. At the
26 end of the study participants were debriefed as to the nature of the study and given the
27 option of withdrawing from the study. No participants chose to do so.

28

29 *Piloting*

30 Piloting was used to identify palatable flavours and brands of popcorn. A group of eight
31 colleagues blind tasted and rated seven varieties of pre-prepared and fresh popcorn.

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1 Preference ratings were used to identify the sweet and savoury popcorn with the highest
2 ratings for use in the main study.

3

4 *Randomisation*

5 On arrival at the cinema participants were given a card with their unique study number
6 printed on it. Study numbers were allocated sequentially according to the order in which
7 participants arrived at the cinema. Participants were then directed through two sets of doors
8 to the auditorium where the experiment took place. On entering the auditorium a
9 predetermined random number sequence was used to allocate participants, by unique study
10 number, to study arm.

11

12 *Procedure*

13 Following randomisation participants were given their choice of toffee or salt popcorn which
14 was bagged in pre-weighed quantities and the bag placed in a popcorn tub. To ensure
15 participants received amounts of popcorn that were visually similar, participants received
16 120 grams of salted popcorn and 450 grams of the much heavier toffee popcorn.
17 Participants also received a 500ml bottle of mineral water and a study questionnaire. To
18 ensure participants observed the nutritional label, on giving participants their popcorn the
19 researcher pointed to the study label, also indicating the flavour, and asked the participant if
20 that was their flavour preference. Participants were shown to their seats by another
21 member of the research team. Seats were spaced apart to avoid the sharing of popcorn and
22 observation by participants of the different labels. Participants completed the first part of
23 the questionnaire prior to tasting their popcorn. To maintain the appearance that the
24 researchers were interested in the effect of emotion on taste, participants then watched a
25 “sad” section of the Disney Pixar film Up! lasting approximately 25 minutes. There was then
26 an interval during which they completed the second section of the questionnaire. A “happy”
27 section of the same film, also lasting about 25 minutes was then shown after which
28 participants completed the final section of the questionnaire. Participants were asked to
29 leave their remaining popcorn under their seats as they left. They were then given the
30 debriefing sheet and a £30 voucher as compensation for their time.

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1 *Measures*

2 Primary endpoint

3 Total energy consumed: objectively assessed by weighing the popcorn remaining in the
4 carton and subtracting it from the amount served. Energy consumption was chosen as the
5 primary endpoint in line with previous studies which, regardless of whether the nutritional
6 label highlighted energy or fat, have assessed energy consumption as the primary outcome.

7

8 Putative secondary endpoints (not reported here)

9 These were completed at the beginning, midpoint and end of the experimental session to
10 maintain the appearance that the purpose of the study was to assess the impact of emotion
11 on taste:

12 1. Taste of the snack: five items assessed the extent to which the participant rated the
13 popcorn as good-tasting, strong tasting and unpleasant tasting.

14 2. Emotional state: six items assessed the extent to which the participant feels happy,
15 relaxed, cheerful, tense, sad and upset.

16

17 Demographic characteristics

18 1. Age, gender and SES calculated using the Indices of Multiple Deprivation
19 (Department for Communities and Local Government, 2010).

20 2. Body Mass Index: calculated from self-report of height and weight.

21 3. Weight concern: assessed using two items asking whether participants were
22 currently dieting to try to lose weight or to maintain their weight (Stice, Presnell,
23 Lowe, & Burton, 2006). This dichotomous measure was used in preference to a
24 continuous measure of dietary restraint to minimize participant response burden.

25

26 *Analysis*

27 Calculation of the energy consumed was based on the nutritional information provided by
28 the popcorn manufacturer. Because the two types of popcorn have different weights by
29 volume, consumption data were transformed and z scores used in analyses. BMI was used as
30 a continuous variable in all analyses, but was categorised for graphical display into three
31 groups representing under or normal weight, overweight and obese. SES was assessed using
32 the Indices of Multiple Deprivation (Department for Communities and Local Government,

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1 2007) derived from postcodes. Scores range from 1 (least socially deprived) to 100 (most
2 socially deprived). As the scores do not represent an interval scale, the variable was recoded
3 as an ordinal variable by dividing scores into tertiles to represent three levels of SES: highest,
4 intermediate and lowest. Weight concern was treated as a dichotomous variable with
5 participants who responded positively to either of the weight concern items considered to
6 be currently weight-concerned.

7 Associations between the study variables were explored using chi square tests. To test
8 Hypothesis I, a between- subjects one-way ANCOVA was conducted with label as the
9 independent variable, flavour of popcorn as a covariate and energy consumption as the
10 dependent variable. These data were not normally distributed with a substantial skew
11 statistic of 1.257 (1.44) and thus ranked data were used in the ANCOVA. Cases were ranked
12 using the *rank data* command in SPSS to create a new variable ranking cases from least
13 consumption (rank=1) to greatest consumption (rank = 289).

14 To test Hypothesis II, four hierarchical multiple regressions were conducted with
15 consumption as the criterion variable. For these regressions two dummy variables indicating
16 the type of label seen were created. The low fat dummy label dichotomised participants in
17 to those who saw a low fat label and those who did not see a low fat label (that is saw either
18 a high fat label or no label). The high fat label dichotomised participants into those who saw
19 a high fat label and those who did not see a high fat label (that is saw a low fat label or no
20 label). The variables entered in each step of the model are shown in Table 1

21 To explore the research question assessing possible three-way interactions of label, BMI or
22 weight concern, and SES on consumption, four hierarchical multiple regressions were
23 conducted with consumption as the criterion variable and using the low and high fat dummy
24 variables. The variables entered in each step of the model are show in Table 1. Given high
25 levels of multicollinearity in the data used in the multiple regression analyses, mean centred
26 data were used.

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Results

Three hundred and twenty-five participants were recruited of whom 38 were excluded due to multiple attendances (n= 14), not leaving their popcorn bags (n=13) or for failure to consume any popcorn (n=11). Two hundred and eighty-seven participants were included in the final analyses of whom 36% were male, 37% were weight-concerned, 50% were overweight or obese and 51% were between 18 and 34 years of age. Chi² tests and one-way ANOVA indicated that randomisation had been successful: there were no significant demographic differences between participants in the three study arms.

The median Indices of Multiple Deprivation score (a higher score indicating greater deprivation) for those categorised as living in the least deprived areas was 23.22 (n=89), for those categorised as living in areas of intermediate levels of deprivation was 35.16 (n= 80), and for those living in areas of highest deprivation was 45.33 (n=82). This indicates a sample with greater levels of deprivation than would be expected from an English population sample for whom the comparable median scores would be 7.59 in the least deprived group, 17.24 in the group with intermediate levels of deprivation and 37.31 in the group with highest levels of deprivation.

Associations between participant characteristics and consumption are shown in Table 2. There were significant positive associations between BMI and gender, age and weight concern. Gender was also positively associated with weight concern. However, none of these variables was associated with consumption. The raw data for energy consumption across the two flavours of popcorn and experimental groups is shown in Table 3. Standardised consumption was compared between those eating toffee and those eating salt popcorn with a significant difference found ($t(285) = 8.61, p < .001$). Therefore in subsequent analyses popcorn flavour was entered as a covariate of consumption.

A priori analyses

Hypothesis I

Contrary to predictions, there were no main effects of experimental group on consumption ($F(2,283) = .317, p = .73$).

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1 Hypothesis II

2 Figure 1 shows the effects of BMI and weight concern on the relationship between label and
3 consumption. BMI did not moderate the effect on consumption of either a low fat label ($\beta=-$
4 $.03$, $t=-.30$, $p=.76$) or a high fat label ($\beta=-.13$, $t=-1.62$, $p=.11$). Weight concern did not
5 moderate the effect on consumption of seeing a low fat ($\beta=.03$, $t=.31$, $p=.76$) or a high fat
6 label on consumption ($\beta=-.12$, $t=-1.30$, $p=.19$).

7 Research Question

8 There was no significant interaction of low fat label, SES and BMI ($\beta=-.02$, $t=-.20$, $p=.84$) but
9 there was a significant 3-way interaction of low fat label, SES and weight concern on
10 consumption such that among those of higher SES, weight concerned eaters seeing a low fat
11 label ate more than non weight concerned eaters seeing a low fat label ($\beta=-.27$, $t=-2.07$,
12 $p=.04$). Figure 2 illustrates that this effect was a consequence of weight concerned eaters of
13 higher SES eating less if they saw a low fat label compared to seeing a high fat label or no
14 label. In contrast, among non restrained eaters of higher SES similar amounts were
15 consumed regardless of the label seen. There were no 3-way interactions between seeing a
16 high fat label, SES and either BMI ($\beta=-.13$, $t=-1.41$, $p=.16$) or weight concern ($\beta=-.01$, $t=-.01$,
17 $p=.91$ on consumption).

18 *Post hoc analyses*

19 The *a priori* analyses indicated possible effects of seeing either a high or a low fat label
20 compared to seeing no label. Specifically, the data in Figure 1 suggested that, although there
21 was no moderating effect of BMI on the relationship between label and consumption, obese
22 participants seemed to eat less in response to seeing either a high or low fat label compared
23 to no label. The data in Figure 2 suggested that weight-concerned participants of lowest SES
24 seemed to eat less in response to seeing either a high or low fat label compared to no label.

25 Post hoc analyses were conducted to explore the effects on consumption of seeing either
26 label compared to not seeing a label. The moderating effects of BMI and weight concern on
27 the effect of seeing either label on consumption was explored. Hierarchical multiple
28 regression analysis indicated a marginally significant moderating effect of BMI ($\beta=-.22$, $t=-$
29 1.88 , $p=.06$) such that in those who saw a label, as weight increased, consumption

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1 decreased (see Figure 3). There was no moderating effect of weight concern on the
2 relationship between seeing either label and consumption ($\beta = -.12$, $t = -.993$, $p = .33$).

3 Post hoc analyses were also conducted to explore the possible 3-way interactions of seeing
4 either label compared not seeing a label, SES and either BMI or weight concern. There was
5 no significant 3-way interaction of seeing either label, SES and BMI ($\beta = -.09$, $t = -1.22$, $p = .22$).

6 The 3-way interaction of seeing either label, SES and weight concern was significant ($\beta = -.34$,
7 $t = -2.04$, $p = .04$).

8 **Discussion**

9 Contrary to predictions, no main effects of nutritional labels on consumption were
10 identified. There were no moderating effects of BMI or weight concern on the relationship
11 between nutritional labels and consumption, Hypothesis II was therefore not supported. The
12 research question explored possible modifying effects of SES and overweight or weight
13 concern on the relationship between nutritional label and consumption. A significant
14 interaction between low fat label, SES and weight concern was found. Specifically, among
15 participants of higher SES and seeing a low fat label, there was greater consumption in those
16 who were weight concerned compared to those who were not weight concerned. In contrast
17 in those of lowest SES who saw a low fat label, there was no association between weight
18 concern and consumption. There was no 3-way interaction of low fat label, SES and BMI.
19 Post hoc tests indicated that seeing either label was associated with significantly reduced
20 consumption as overweight increased and with significantly reduced consumption in weight-
21 concerned participants of lowest SES.

22 These results provide some support for previous research finding paradoxical effects of
23 nutritional labelling. However, taking account of the behaviour of non weight concerned
24 eaters and those seeing different labels, it is apparent that this effect in those of higher SES
25 is a consequence of reduced consumption in non weight concerned eaters seeing a low fat
26 label rather than increased consumption in weight concerned eaters seeing the low fat label.

27 Of potentially greater interest are the high levels of consumption in weight concerned eaters
28 of lower SES who did not see a label and the effect of seeing either type of label on reduced
29 consumption. An explanation for this effect may be found within theories of self-regulation

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1 and ego depletion. Self-regulatory models of behaviour describe the ways in which
2 individuals use physical, psychological and social resources to adjust their behaviour to the
3 environment (Baumeister & Vohs 2007). Theories of ego depletion suggest that we have
4 limited resources to enable the exercise of self regulation (Spears, 2010) and that the
5 depletion of these resources is associated with reduced self-control when faced with difficult
6 decisions (Baumeister, 2002). Recent evidence suggests that poverty is associated with
7 greater ego depletion (Spears, 2010). Poverty gives rise to greater numbers of difficult
8 decisions. For example, if money is spent resolving one problem, it is not available to spend
9 on another problem. These difficult decisions use and deplete the limited cognitive
10 resources available leading to reduced behavioural control. Weight-concerned participants
11 of lowest SES may experience greater difficulty in finding the cognitive resources to facilitate
12 reduced consumption and in the absence of a label eat in response to the reward of
13 satisfying physiological processes of hunger and satiety. In contrast, seeing a low or a high
14 fat label may be a reminder of the goal of limiting energy intake, thus supporting
15 consumption in line with the goal of reduced energy intake. Further research is needed to
16 test these and other possible explanations for behavioural responses to nutritional labelling.

17 Some limitations of the current study should be acknowledged. We assessed dietary
18 restraint using a very brief measure of weight concern and not a validated questionnaire to
19 assess dietary restraint (e.g. Strien, Frijters, Staveren, Defares, & Deurenberg, 1986). This
20 was done to minimise the response burden for a population with limited literacy and to
21 maintain the covert purpose of the study. In the context of a field experiment it was not
22 possible to accurately measure height and weight and thus these data were self reported,
23 which is known to be associated with underestimation of BMI. However, underestimation is
24 likely to be modest and unlikely to have affected the results of this experiment (Lin, DeRoo,
25 Jacobs, & Sandler, 2011). There are also limitations in that only one type of labelling was
26 examined in one very particular environment and so these results cannot be extrapolated to
27 other types of labels across wide range of situations in which people consume foods. In
28 addition we could not assess whether individuals might compensate for their popcorn
29 consumption by eating more or less at subsequent meals. However, given the impossibility
30 of testing the impact of multiple labelling formats across multiple situations, carefully

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1 controlled studies such as this allow high quality evidence to inform systematic reviews and
2 meta-analyses from which widely applicable conclusions can be drawn.

3 There was high multicollinearity in the regression analyses assessing the 3-way moderating
4 effects, thereby reducing the statistical power of these analyses. ANOVA was not
5 appropriate given unequal group sizes and the reduced power that would follow from using
6 BMI as a categorical variable. Therefore, the results of the 3-way interactions explored in
7 the research question warrant replication.

8 We assessed emotion at the three time points across the study. It would have been
9 interesting to have been able to assess whether emotional state had an effect on
10 consumption. However as consumption was only measured once at the end of the study, it
11 was not possible to do this. While we made every effort to exclude repeat attenders, it is
12 possible that some are included in the dataset. Having read the debriefing sheet on their
13 first attendance, they would have been aware of the purpose of the study. Additionally,
14 some participants might have heard about the study, and its purpose, from those attending
15 previous sessions. Those who knew the purpose of the study would know that all the
16 popcorn had the same nutritional content regardless of label and thus their consumption
17 would be unaffected by the label. However, any such participants would have been
18 randomised across the groups so their knowledge would be likely to reduce rather than
19 increase the effects found.

20 This study contributes to the very limited evidence exploring the effects of nutritional
21 labelling on consumption in a general population sample. The results highlight the different
22 effects of labelling across those with different SES. The findings add to the evidence
23 suggesting paradoxical effects of nutritional labelling, but only in those of higher SES. In
24 those of lower SES there is evidence that nutritional labelling, at least in the case of simple
25 colour coded labels, may support weight-concerned participants in achieving their goal of
26 limiting intake.

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1 **Table 1: Variables entered at each step of regression analyses used in a priori and post hoc analyses**

Analysis	Step 1:	Step 2	Step 3	Step 4	Step 5
Hypothesis II: 2-way interaction effects on consumption					
Interaction: BMI and low fat label.			BMI Low fat label	2-way interaction: BMI x low fat label	
Interaction: BMI and high fat label	Age*		BMI High fat label	2-way interaction: BMI x high fat label	
Interaction: weight concern and low fat label.	Gender SES**	Popcorn flavour	Weight concern Low fat label	2-way interaction: Weight concern x low fat label	
Interaction: weight concern and high fat label.			Weight concern High fat label	2-way interaction: Weight concern x high fat label	
Research Question: 3-way interaction effects on consumption					
Interaction: BMI, low fat label and SES.			BMI Low fat label SES	2-way interactions: BMI x low fat label, BMI x SES SES x low fat label	3-way interaction: BMI x low fat label x SES
Interaction: BMI, high fat label and SES			BMI High fat label SES	2-way interactions: BMI x high fat label BMI x SES SES x high fat label	3-way interaction: BMI x high fat label x SES
Interaction: weight concern, low fat label and SES.	Age Gender	Popcorn flavour	Weight concern Low fat label SES	2-way interactions: Weight concern x low fat label Weight concern x SES SES x low fat label	3-way interaction: weight concern x low fat label x SES
Interaction: weight concern, high fat label and weight concern.			Weight concern High fat label SES	2-way interactions: Weight concern x high fat label Weight concern x SES SES x high fat label	3-way interaction: weight concern x high fat label x SES

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Post hoc analysis I: 2- way interaction effects on consumption					
Interaction: BMI and seeing either label.	Age Gender SES	Popcorn flavour	BMI Seeing either label	2-way interaction: BMI x seeing either label	
Interaction: weight concern and seeing either label.			Weight concern Low fat label	2-way interaction: Weight concern x seeing either label	
Post hoc analysis II: 3 way interaction effects on consumption					
Interaction: BMI, seeing either label and SES.	Age Gender	Popcorn flavour	BMI Seeing either label SES	2-way interactions: BMI x seeing either label BMI and SES Seeing either label and SES	3-way interaction: BMI x seeing either label x SES
Interaction: weight concern, seeing either label and SES.			Weight concern Low fat label SES	2-way interaction: Weight concern x seeing either label Weight concern and SES Seeing either label and SES	3-way interaction: Weight concern x seeing either label x SES

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2 *Age categorised as younger (18 – 34 years) or older (35 or over).

3 **SES categorised as socially deprived (lower SES) or not socially deprived (intermediate or higher SES)

1 **Table 2: Associations between key study variables (Pearson chi square statistic)**

	Gender	Age	SES	Weight concern
BMI†	5.53 ($p=.06$)	19.09*	8.30 ($p=.08$)	7.52*
Gender		3.54	2.49	7.45**
Age††			10.91	6.38
SES†††				8.17*

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* $p < .05$ ** $p < .01$

† Coded: 1= not overweight, 2= overweight, 3= obese.

†† Coded: 1= 18-24, 2= 25-34, 3=35-44, 4= 45-54, 5=>55.

††† †Coded: 1= least deprived, 2= intermediate levels of deprivation and 3 highest levels of deprivation.

10 **Table 3: Descriptive statistics for energy consumption (in calories) by experimental group**
11 **and popcorn flavour chosen (M(SD))**

	Toffee		Salt	
	N	m(sd)	n	m(sd)
No label control group	56	599.69 (385.69)	32	237.73 (132.84)
Low fat label	63	502.39 (313.12)	40	245.03 (143.31)
High fat label	58	524.06 (337.60)	38	244.63 (137.52)
Total	177	540.27 (345.92)	110	242.77 (319.05)

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Figure 1: Effect of label on standardised energy consumption by a) BMI and b) weight concern

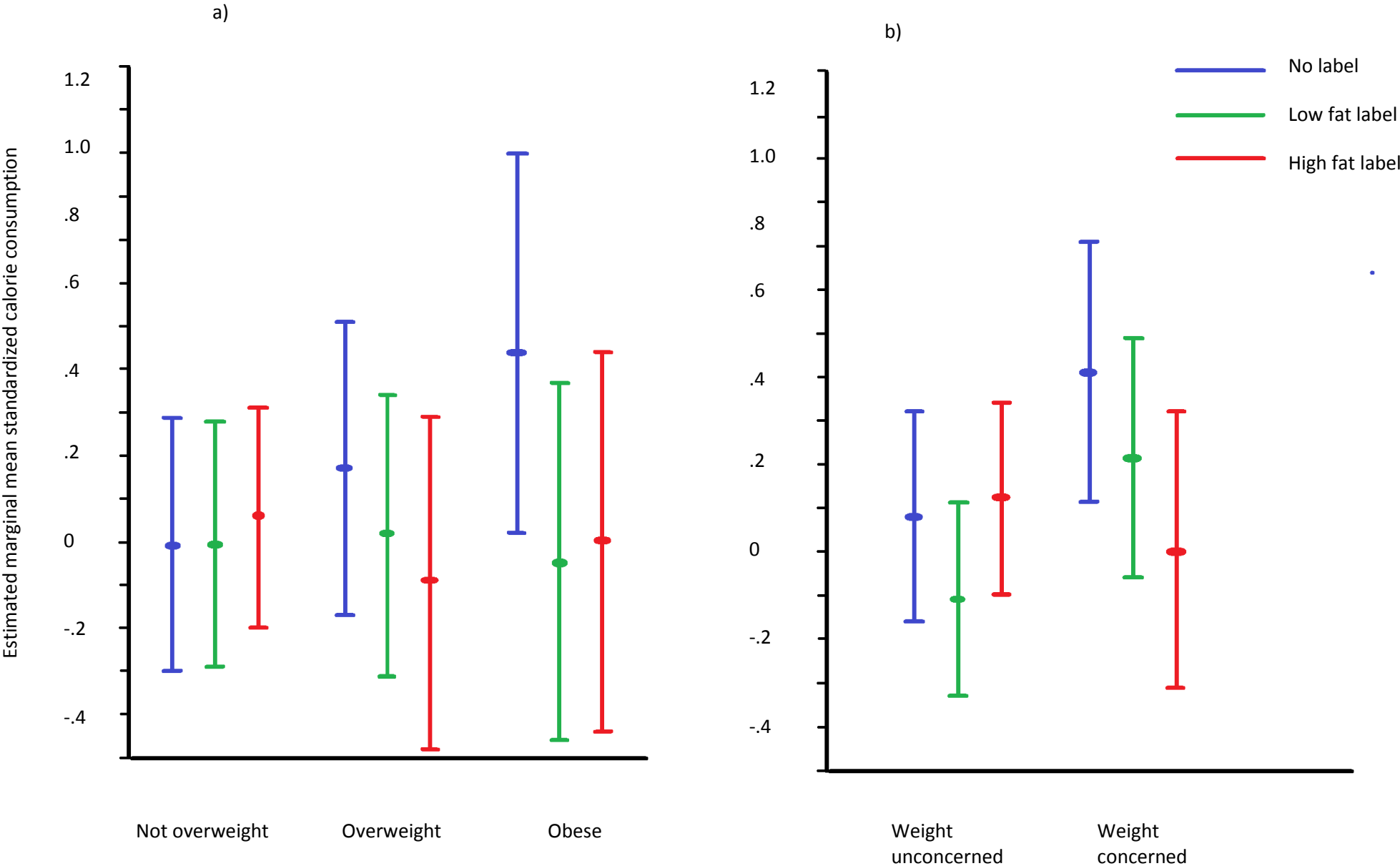


Figure 2: Moderating effects of weight concern on the relationship between label and standardised energy consumption in those with higher and lower SES.

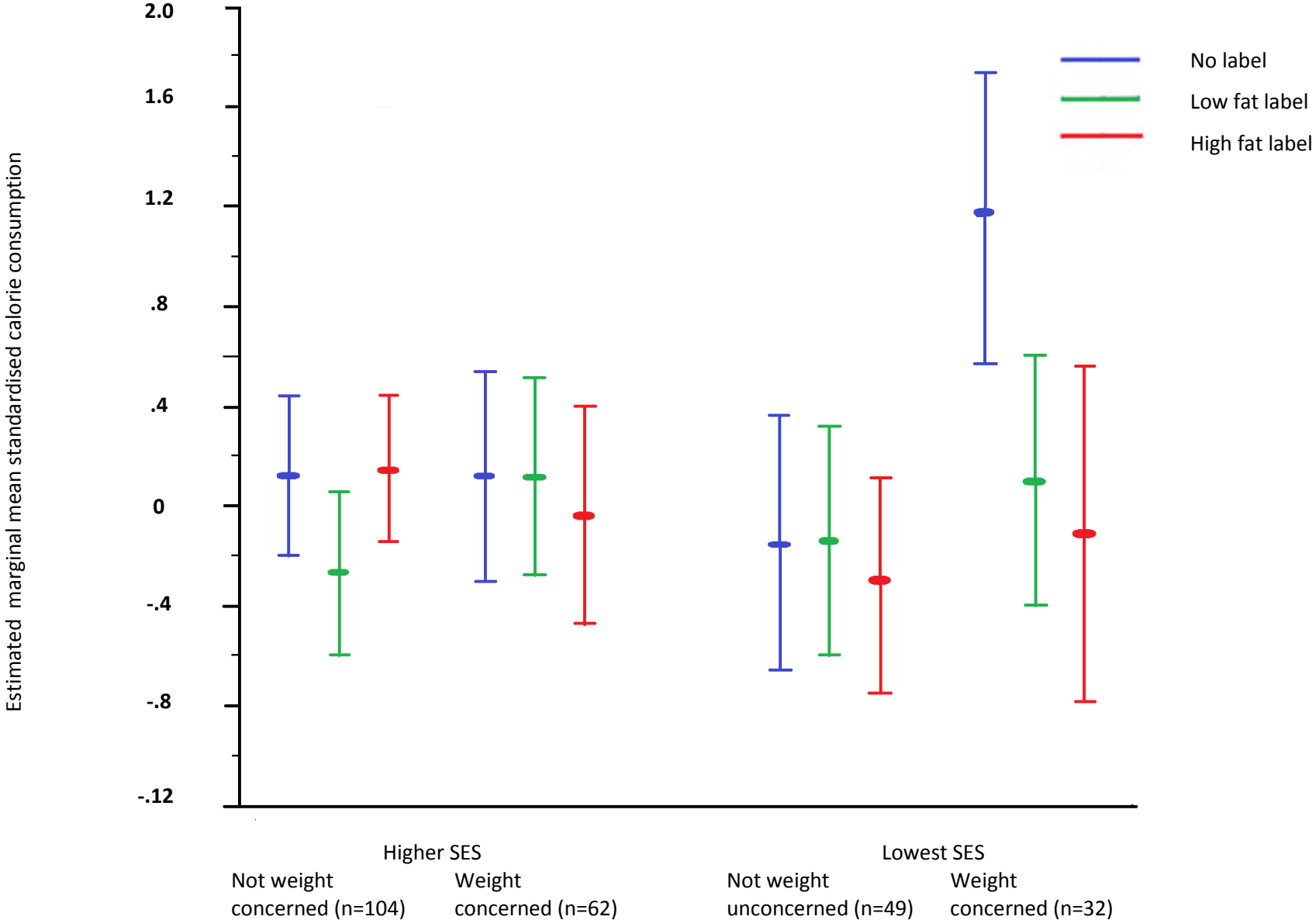


Figure 3: Marginal moderating effect of BMI on the relationship between seeing a label or no label on standardised energy consumption

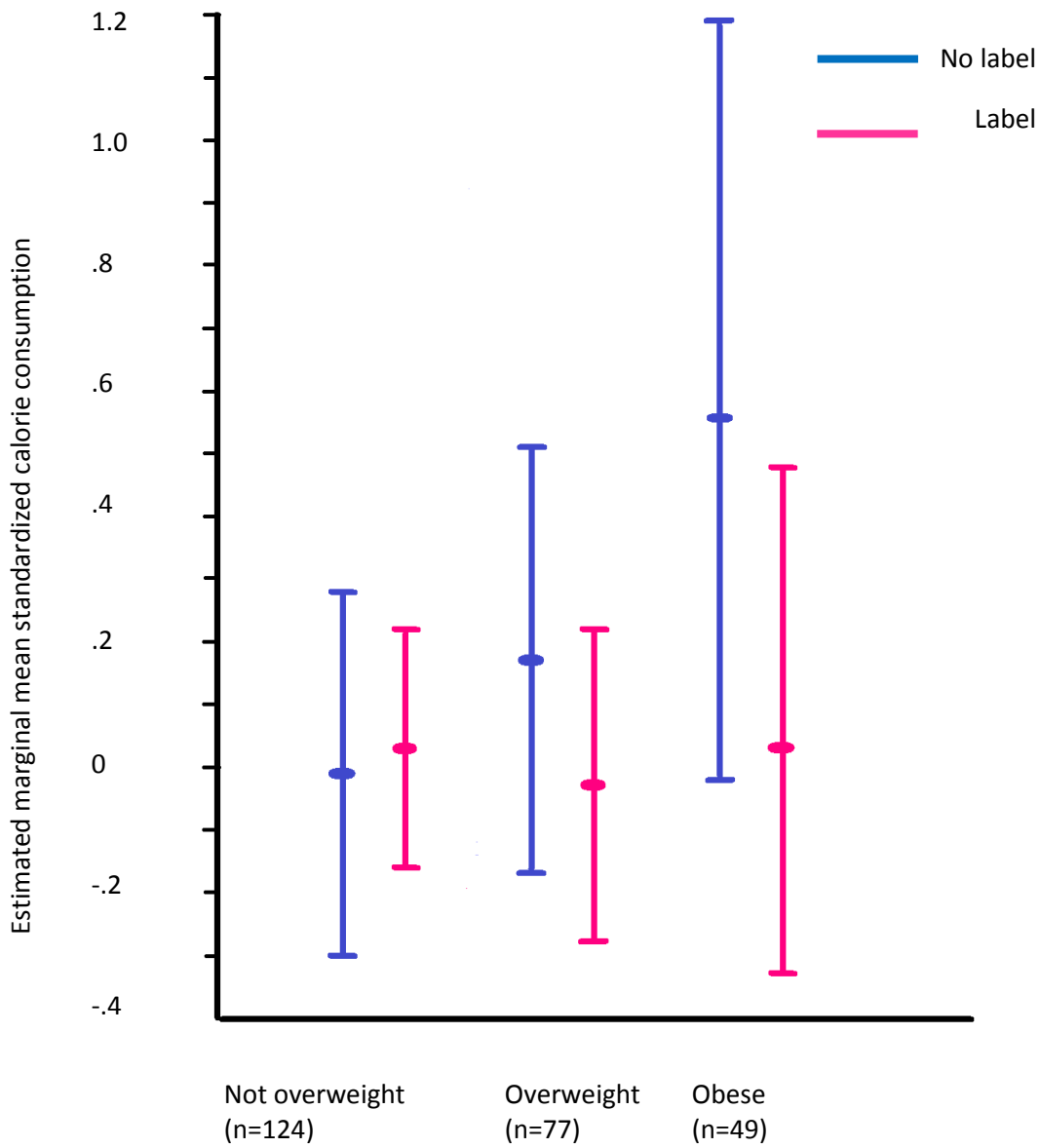
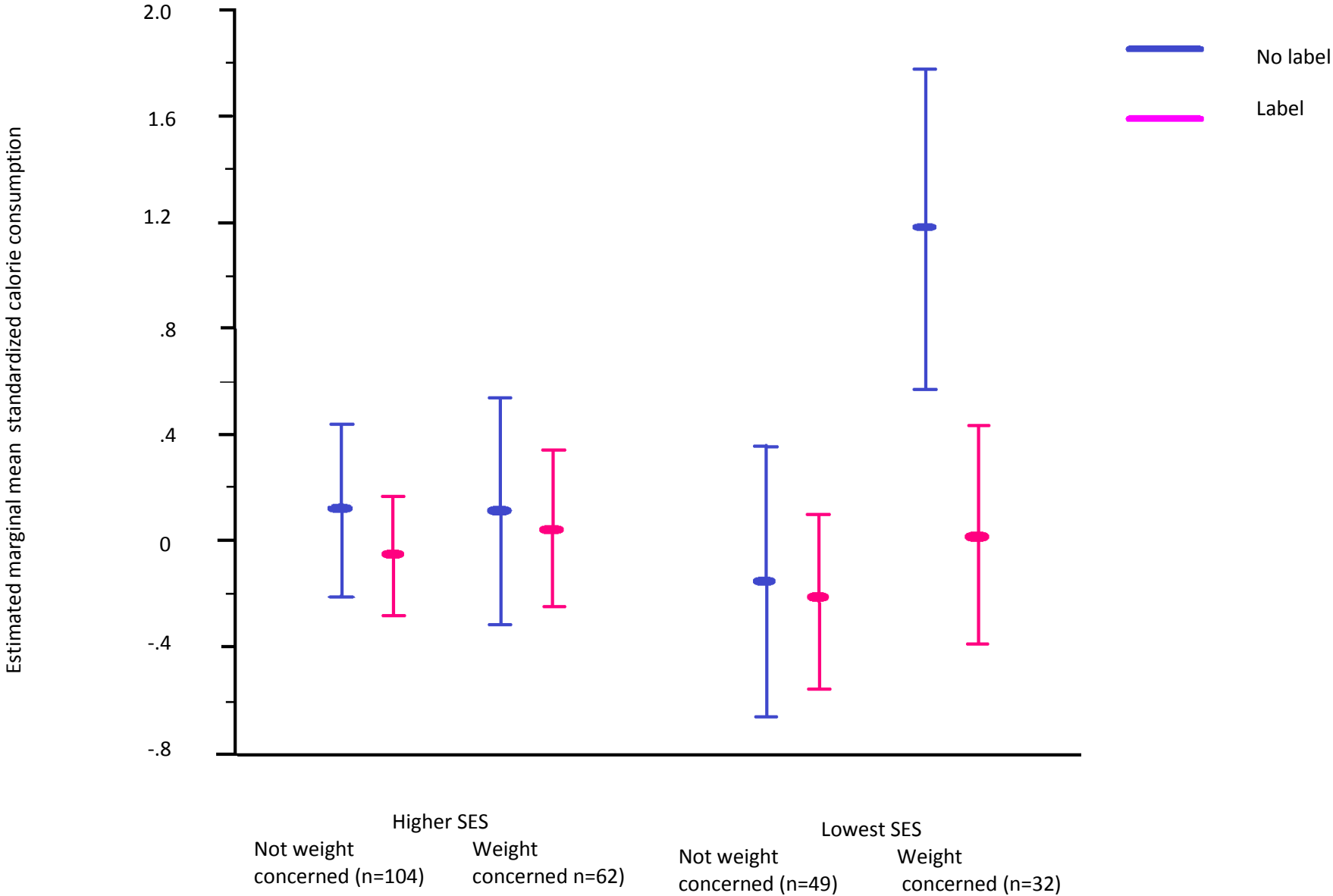


Figure 4: Three way interaction of seeing a label or not, SES and weight concern on estimated marginal standardised energy consumption.



Appendix 1: Labels indicating flavour of popcorn and fat content.



**Salted
popcorn**



**Toffee
popcorn**



**Salted
popcorn**



**Toffee
popcorn**