Starting university with high eating self-regulatory skills protects students against unhealthy dietary intake and substantial weight gain over 6 months

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Acknowledgments

RJB, FJ and HC were funded by Cancer Research UK when this research was carried out, and NK by CAPES/BRASIL. RJB is now supported by Yorkshire Cancer Research Academic Fellowship funding

Abstract

Background: There is consistent evidence that suggests first year students are at risk of weight gain, but the reasons for this vulnerability are still unclear. This study aimed to explore whether the ability to regulate eating behaviours is a predictor of weight and dietary changes in first year undergraduate students.

Methods: First year undergraduate students from universities situated in London were invited to complete a survey at the beginning of the academic year and at 6-month follow-up. Each survey included the Self-Regulation of Eating Behaviour Questionnaire, food frequency questions, socio-demographic questions and anthropometric questions. Linear and logistic regressions were performed to explore the effect of baseline eating self-regulatory skills on weight and dietary changes.

Results: 481 first year undergraduate students took part in the study. Students who entered university with higher eating self-regulatory skills were more likely to maintain or achieve a higher fruit and vegetable (OR=1.8, p=.007) and a lower sweet and salty snack (OR=1.9, p=.001) intake over the course of the first 6 months in university. Higher baseline eating self-regulatory skills were also related to lower weight changes (β=-.15, p=.018) and lower likelihood of gaining 5% initial body weight (OR=.52, p=.006) at 6-month. Additionally, self-regulatory skills moderated the relationship between baseline BMI and weight changes (β=-.25, p=<.001) and between baseline BMI and 5% weight gain (OR=0.82, p=0.008).

Conclusions: Starting university with higher eating self-regulatory skills may help students to maintain or achieve a healthy diet and protect them against substantial weight gain, especially among students with overweight.

Keywords: Weight change; eating behaviours; self-regulation; population studies; freshman year.

1. Introduction

The transition to university is a period characterised by changes in lifestyle, environment and responsibilities. In the late 1990's, a belief that this period leads to dramatic weight gain, identified as the 'Freshman 15 pounds (6.8kg)' was widely spread by newspapers and academic articles (Brown, 2008; Graham & Jones, 2002). More recent studies have indicated a lower, but still significant, weight gain among students starting university (Crombie, Ilich, Dutton, Panton, & Abood, 2009; Morrow et al., 2006). A review and meta-analysis (Vella-Zarb & Elgar, 2009) found students gain on average 1.75 kg (95%CI 1.73; 1.77) over the course of their first year.

However, the reasons for this vulnerability to weight gain and individual differences in the experience are still unclear. Reviews suggest weight gain in first year undergraduate students is associated with high baseline weight, dietary changes, decreases in physical activity, living in residential halls, level of stress, and dietary restraint (Crombie et al., 2009; Vella-Zarb & Elgar, 2009). Genetic influences may also play a role (Meisel, Beeken, van Jaarsveld, & Wardle, 2015). However, higher baseline weight is not always a predictor of weight gain. A study conducted with 120 first year students from the UK found that students with a lower baseline weight actually gained the most weight over a 12-month period (Finlayson, Cecil, Higgs, Hill, & Hetherington, 2012). Regarding the relationship between dietary changes and weight gain, a study with first year students from the United States found that weight gain in male students (N=140) was predicted by an increase in alcohol consumption whereas in female students (N=256) it was predicted by lower fruit and vegetable intake (Economos, Hildebrandt, & Hyatt, 2008). In contrast, some studies have found that dietary behaviours neither change nor predict weight gain in first year undergraduate students (Boyce & Kuijer, 2015; Nikolaou, Hankey, & Lean, 2015). These inconsistencies may be due to a lack of

power to detect changes or due to the use of different measures to assess weight, physical activity and dietary behaviours.

However, it is important to note that weight gain over the first year at university may not always represent a concerning change. Small weight gains may represent natural daily weight fluctuation (Orsama et al., 2014) or even be a positive change for people who had a very low body mass index (BMI). There is also evidence that some students may experience weight loss during this transition (Gillen & Lefkowitz, 2011; Vadeboncoeur, Foster, & Townsend, 2016). Thus, further research into the mechanisms of weight change (as opposed to just the drivers of weight gain) during the transition to university is warranted.

It has been suggested that stress may increase both risk of weight loss and weight gain (Serlachius, Hamer, & Wardle, 2007). According to Boyce and Kuijer (2015) people who enter university with higher levels of stress and lower BMI may lose weight, while those with higher BMI may gain weight. Studies have also shown that increased social support may be a possible buffer of the negative effect of stress on weight gain over the freshman year, especially among men (Darling, Fahrenkamp, Wilson, Karazsia, & Sato, 2017). Increases in physical activity and a decreases in calorie intake may also lead to weight loss during the transition to university (Hootman, Guertin, & Cassano, 2017). However, the transition to university has also been linked to an increased risk of developing eating disorders (Delinsky & Wilson, 2008; Striegel-Moore, Silberstein, & Rodin, 1986). Delinsky and Wilson (2008) found that women with higher dietary restraint and concerns about their weight during the first year at university were more likely to lose weight and show disordered eating symptoms.

However, with respect to dietary restraint, that is - the intention to eat less in order to stay in shape (Herman & Polivy, 1975), and its relationship with weight changes, other studies have shown conflicting results. For example, Provencher et al. (2009) found in a cohort of first year students (N=2921) from Canada that high levels of dietary restraint were related to both

weight loss and weight gain. Researchers have suggested that some restraint scales, such as the Restraint Scale (Herman & Polivy, 1975), assess a range of personality traits and eating tendencies (such as the susceptibility to overeat and weight fluctuation) rather than the intent to exercise dietary restraint, and that this may have contributed to mixed results (Hagan, Forbush, & Chen, 2017; Laessle, Tuschl, Kotthaus, & Pirke, 1989; Williamson et al., 2007). As a result, researchers have developed psychometric scales assessing just dietary restraint and no other traits, but this has not solved the issue of inconsistent results for the relationship with weight control (Johnson, Pratt, & Wardle, 2012; Williamson et al., 2007). Some authors have argued that inconsistent results may be because some restrained dieters have higher eating self-regulatory skills than others and may be more capable of maintaining or losing weight (Hays & Roberts, 2008; Johnson, Pratt, & Wardle, 2012; Phelan et al., 2009).

Self-regulatory skills are often conceptualized as the individual's ability to alter their behaviour, thoughts, feelings and attention in the pursuit of their personal goals (Boekaerts, Maes, & Karoly, 2005; Carver & Scheier, 2001; De Vet et al., 2014; Moilanen, 2007), for example, the ability to inhibit a desire to have a sweet in order to stay healthy. Most theoretical models define self-regulatory skills as a continual and multi-level process involving self-monitoring; appraising progress and attempting to approach or maintain the desired goal; making adjustments to it when necessary or giving up (Bandura, 1991; Baumeister, Vohs, & Tice, 2007; Rasmussen, Wrosch, Scheier, & Carver, 2006; Schwarzer, 2008).

Given the dramatic changes in routine, environment and social life experienced by first year undergraduate students, some level of self-regulatory skills may be required to keep healthy habits and/or build new ones due to disruptions of old habitual behaviours. The new environment may also increase demands on self-regulation to inhibit impulses towards food

temptations, since students can experience a high exposure to unhealthy food options at university (Grech, Hebden, Roy, & Allman-Farinelli, 2016).

A recent online study conducted with 923 adults in the UK showed that higher eating self-regulatory skills were related to higher fruit and vegetables intake and to lower unhealthy snack intake and sugary drinks intake, as well as lower BMI (Kliemann, Beeken, Wardle, & Johnson, 2016). Similar results were found in studies conducted specifically with undergraduate students (Price, Higgs, & Lee, 2017; Schroder, Ollis, & Davies, 2013; Tomasone, Meikle, & Bray, 2015). However, the majority of these studies had cross-sectional designs, which cannot indicate causality. Additionally, although the transition to university tends to promote weight gain and unhealthy dietary changes (Vella-Zarb & Elgar, 2009), no study has assessed the effect of self-regulatory skills on weight and dietary changes among first year undergraduate students.

Therefore, this study aimed to examine relationships between eating self-regulatory skills and changes in weight and dietary behaviours over 6 months in an online longitudinal cohort of undergraduate students from London, UK. This study hypothesised that high eating self-regulatory skills at baseline would prevent weight gain and be related to weight loss, as well as, help people to achieve or maintain healthier dietary behaviours over the first 6 months at university. People who worsened their dietary behaviours and those who maintained an unhealthy diet over the first 6 months at university would have lower eating self-regulatory skills at baseline.

2. Material and Methods

2.1 Participants

Participants were first year undergraduate students from 13 universities within London, chosen based on convenience and having at least one university representing each of the

seven regions of London. The Departments and/or Faculties within each university were individually contacted and invited to take part in the study. All interested students aged between 18 and 30 years able to give informed consent and willing to complete the online survey twice over a 6-month period were eligible. Participants who were 30 years old or over were excluded, as older students might not be as susceptible to weight gain as younger students (Hulanicka & Kotlarz, 1983). A criterion for height changes was established to allow for reporting errors (+/- 1 cm); participants with a height change ≤-1 or ≥4 cm were excluded from the analyses.

2.2 Procedure

The Departments or Faculties that agreed to take part in the study invited all of their first year undergraduate students to complete the online survey at the beginning of the academic year (September/October 2015) through an email circular. Interested students who consented to participate were directed to the online survey on Survey Monkey (2015). At 6-month follow-up (March/April 2016), participants were invited to complete the online survey for the second time. As an incentive, participants had the chance to enter a draw to win a £20 high street voucher. Ethical approval was granted by the University College London Research Ethics Committee.

2.3 Measures

2.3.1 Predictor variable

Eating self-regulatory skills at baseline was assessed using the valid and reliable 5-item Self-Regulation of Eating Behaviour Questionnaire (SREBQ) (Kliemann, Beeken, Wardle, & Johnson, 2016b). Response options ranged from 1 (never) to 5 (always). Total mean score was calculated. The SREBQ demonstrated good internal reliability at baseline (Cronbach's alpha=.73).

168 2.3.2 Outcome variables

169 Weight and height were self-reported, as first year students tend to provide reliable
170 anthropometric data (Vella-Zarb & Elgar, 2009). Changes from baseline to 6-month follow-
171 up were calculated for absolute weight in kg and categorised into **1)** ≥5% initial body weight
172 gain (substantial weight gain) or <5% initial body weight gain and; **2)** ≥5% initial body
173 weight loss or <5% initial body weight loss. These criteria for categorising weight changes
174 were based on the current evidence suggesting health benefits of losing 5% of initial body
175 weight, such as improvements in blood pressure, blood cholesterol, and blood sugars (Brown,
176 Buscemi, Milsom, Malcolm, & O'Neil, 2016; Van Gaal, Mertens, & Ballaux, 2005; Vidal,
177 2002). Following the same principle, gaining 5% of initial body weight could be considered a
178 significant amount of weight since it may increase individuals' risk for these health issues,
179 especially among individuals with overweight and obesity. Additionally, BMI was calculated
180 and categorised into underweight (BMI<18.5kg/m2); normal weight (BMI 18.5 to 24.9
181 kg/m2) or overweight or obese (BMI 25kg/m2 or over)(WHO, 2015).

182 Participants were asked to answer the question 'How frequently do you typically eat fruit and
183 vegetables (FV)' in both surveys (baseline and 6 months) via a valid 7-point scale that ranged
184 from 'less than once a week' to '3 or more a day' (Cappuccio et al., 2003). This scale was
185 then adapted to assess the frequency of sweets and salty snacks (SSS), and sugary drinks
186 (SD) intake. Answers were recoded to represent daily intake, for example, '2-3 times a week'
187 was coded as 0.36. High and low intake were defined using percentile ranks of the scores at
188 baseline. For FV, the 75th percentile was the cut-off point for high intake, while scores that
189 fell below this percentile represented a low intake. Regarding SSS and SD, the 25^{th} percentile
190 was the cut-off point for low intake, and scores above this percentile were classified as high
191 intake. Participants who presented a high FV and a low SSS and SD at 6 months, where

192 categorised as those who managed to maintain or achieve healthier dietary behaviours over 6
193 months.

194 2.3.3 Socio-demographic and other variables

195 Data on age, gender, ethnicity (White; Black; Asian; Mixed or Other), and living
196 arrangements (living in college/university halls, renting from the local authority or privately,
197 living with parents or owning their home) were collected.

198 **2.4 Sample size**

199 A sample of at least 286 participants was aimed for to detect a medium effect (R^2=0.15) of
200 eating self-regulatory skills on weight or dietary behaviours, when running multiple
201 regression tests with up to 10 predictors (Field, 2012). The sample size calculation ensured
202 95% power, a significance level of 0.01% and allowed for 50% attrition, based on a previous
203 online study (Boyce & Kuijer, 2015). The calculation was performed using G*Power 3.1.5
204 software.

205 **2.5 Statistical analysis**

206 Descriptive analyses were used to characterize the sample. Baseline differences between
207 completer and drop-out participants were checked using Chi-square tests for categorical
208 variables, and T-test or Mann-Whitney tests for continuous variables. Completers were
209 defined as those participants with data at baseline and follow-up, while drop-outs were those
210 with missing data at follow-up.

211 Pearson's or Spearman's correlations were carried out to assess associations between eating
212 self-regulatory skills, weight, dietary intake and socio-demographic characteristics at
213 baseline. Ethnic origin was dichotomised into white ethnicity or other ethnicity; and living
214 arrangements into living in college/ university halls or not; living with parents or not; and
215 renting or owning a home or not.

Change in weight between baseline and 6-month follow-up was explored using paired t-tests. Cohen's effect size was calculated. Chi-square tests were used to assess differences in dietary behaviours (percentage of high and low intake) over 6 months.

Hierarchical multiple linear regression analyses explored the association between eating self-regulatory skills and weight changes. The first step included only eating self-regulatory skills, while age, gender, ethnic origin, baseline BMI and height changes were entered in step 2 and interactions between eating self-regulatory skills and covariates were entered in step 3. Only significant interactions were included.

Binary logistic regression was performed to explore the associations between eating self-regulatory skills and risk of gaining 5% of initial body weight; likelihood of losing 5% of initial body weight and maintaining or achieving the three healthy dietary behaviours at 6-month follow-up. Separate models were run for each outcome. Following the same order as in the linear regression, binary models included eating self-regulatory skills in step 1, covariate variables in step 2 and interaction terms between self-regulatory skills and covariates in step 3.

All analyses were performed using IBM SPSS statistics version 22 (SPSS Inc., Chicago, IL, USA). Due to the number of analyses, a more stringent p-value of ≤ 0.01 was considered statistically significant for this study.

3. Results

A total of 815 students were interested in taking part in the study and provided baseline data. Of these, 334 had to be excluded for the following reasons: did not accept to be contacted a second time (N=186); were not a first year undergraduate student (N=85); reported a height change outside the acceptable range (N=38); were from a university based outside London

(N=13); or were 30 years or over (N=12). The final sample consisted of 481 students, and 262 completed the 6-month follow-up survey (54.3%).

The sample's characteristics at baseline are presented in Table S1. The majority was female (76.5%), white (59.7%), living in halls (70.7%) and had a healthy weight (73.4%). The mean age was 19 years old and mean weight was 60 kg. Students reported consuming on average less than 2 servings of FV per day and having SSS 4-6 times per week and SD 2-3 times a week. A total of 262 participants provided data at 6-month follow-up and they did not differ significantly from non-completers at baseline for the majority of the variables, with the exception of gender, ethnicity and sugary drink intake. The completer group had a significantly higher proportion of female (80.9% vs 71.2%, p=0.01) and white (64.9% vs 53.4%, p=0.012) participants and tended to drink sugary drink less frequently at baseline (0.28 vs 0.37, p=0.020).

At baseline, higher eating self-regulatory skills was associated with consuming more servings of FV (r=0.30, p<0.01), fewer SSS occasions (r=-0.34, p<0.01) and lower SD intake (r=-0.22, p<0.01). There were no significant correlations between baseline eating self-regulatory skills and baseline weight, gender, age, ethnicity or living arrangements (Table S2).

3.1 Change in weight and dietary behaviours over 6 months

Over 6 months a mean weight change of 0.66 kg (sd=3.83) was observed, and this was statistically significant (t(254)=2.752, p=0.006), representing a small-sized effect (d=0.17). The range of weight change varied widely (-11.3 kg to +26.2 kg). No changes were reported in a small number of participants (19.6%, N=50), while about a third lost weight (30.6%, N=78) and about half gained weight (49.8%, N=127). Among students whose weight increased over 6 months (N=127), the mean weight gain was 3.30 kg (sd 3.16). Around a quarter of participants (23.5%, N=60) gained 5% or more of their initial body weight.

The percentage of people with a high FV intake from baseline to 6-month follow-up did not significantly change (25.4 to 30.5%, p=0.14). The percentage of people with a high frequency of SSS intake increased significantly (50.1 to 59.9%, p=0.01) over 6 months. Conversely, there was a significant decrease (55.9 to 46%, p=0.01) in the percentage of people with a high frequency of SD intake over 6 months. About 30% of participants managed to achieve or maintain a higher intake of FV, while about 40% and 50% of participants managed to achieve or maintain a low intake of SSS or SD, respectively, over the first 6 months at university.

3.2 Eating self-regulatory skills and weight changes at 6 months follow-up

Table 1 shows that the adjusted regression model (Model 2) accounted for 6.8% of the variance in weight changes (p=0.009). However, only baseline BMI was a significant predictor (β=-0.21, p=0.002). The inclusion of interaction terms between Self-Regulation of Eating Behaviour (SREB) and covariates (Model 3) significantly improved the model fit by 7% (ΔF=9.986, p<.001). Here, eating self-regulatory skills significantly predicted weight changes (β=-0.15, p=0.01), alongside baseline BMI (β=-0.30, p<0.001). There was also an interaction between baseline BMI and eating self-regulation (β=-0.25, p<0.001) and between ethnicity and eating self-regulatory skills (β=0.16, p=0.01).

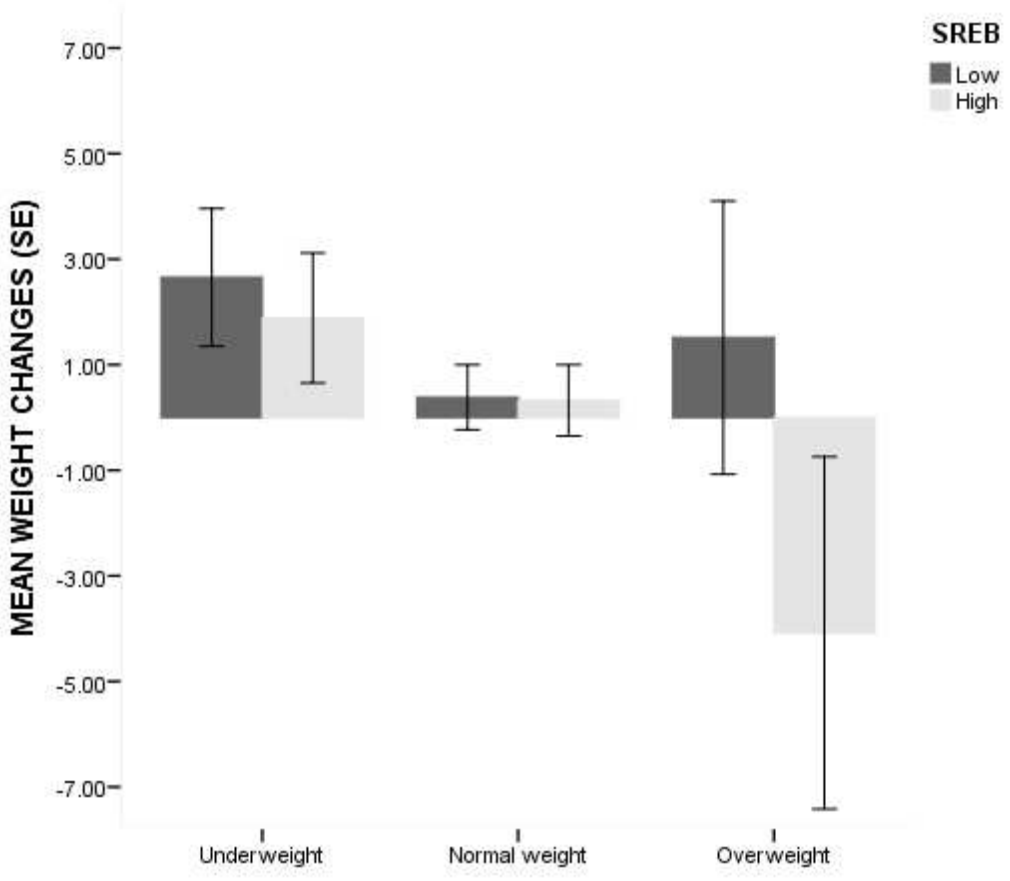
Table 1 Predictors of changes in weight at 6-month follow-up

Weight Changes	Model 1 Unadjusted			Model 2 Adjusted			Model 3 Adjusted		
	B (SE)	β	p	B(SE)	β	p	B(SE)	β	p
Constant	0.58 (0.22)		**0.009**	0.59 (0.22)		**0.008**	0.49 (0.22)		0.025
SREB[a]	-0.41 (0.32)	-0.07	0.194	-0.64 (0.32)	-0.13	0.045	-0.73 (0.30)	-0.15	**0.018**
Age				0.09 (0.13)	0.04	0.491	0.04 (0.13)	0.02	0.748
Gender[b]				-0.46 (0.56)	-0.06	0.413	-0.54 (0.55)	-0.06	0.327
Ethnicity[c]				-0.70 (0.46)	-0.09	0.130	-0.73 (0.45)	-0.10	0.103
Baseline BMI				-0.23 (0.07)	-0.21	**0.002**	-0.32 (0.07)	-0.30	**<0.001**
Height changes				0.47 (0.23)	0.13	0.037	0.43 (0.22)	0.12	0.049
Ethinicity*SREB							1.58 (0.62)	0.15	**0.011**
BMI*SREB							0.38 (0.09)	-0.25	**<0.001**
Model fit	R^2=0.007 & R^2 adj=0.003 F=1.694, p=0.194			R^2=0.068 & R^2 adj=0.044 F=2.909, p=0**.009** ΔR^2=0.061, ΔF=3.137**, p=0.009**			R^2=0.14 & R^2 adj=0.11 F=4.842, p<0.**001** ΔR^2=0.07, ΔF=9.986, **p<0.001**		

Note: [a]Eating self-regulatory skills at baseline. [b]Gender, Male=0 and Female=1. [c]Ethnicity, White=0 and Other=1. P-value of ≤0.01 was considered statistically significant

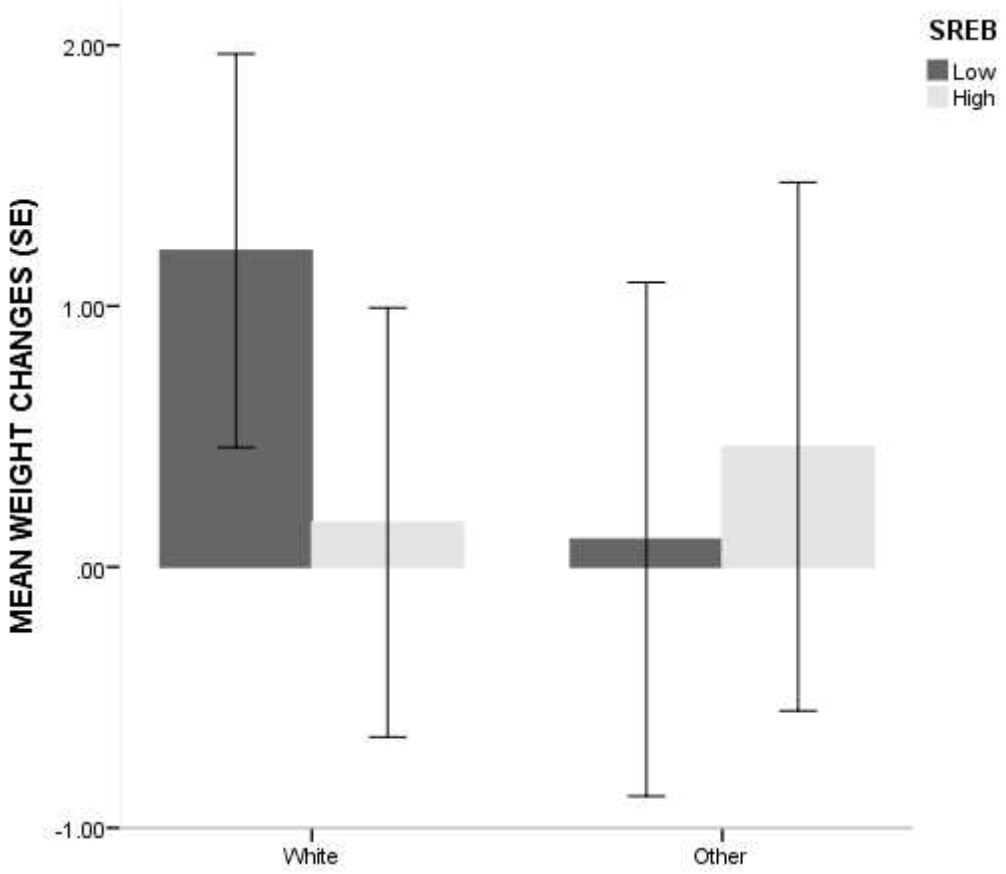
Figure 1 illustrates that higher eating self-regulatory skills (>3.6) predicted decreases in weight among students with overweight (BMI≥25 kg/m^2), while those with normal weight (BMI between 18.5 and 24.9 kg/m^2) and underweight (BMI <18.5 kg/m^2) showed increases in weight regardless of their baseline level of eating self-regulatory skills. Lower eating self-regulatory skills predicted increases in weight among white students, while no effect was found for other ethnicities (Figure 2).

Figure 1 Interaction between baseline BMI and baseline eating self-regulatory skills as a predictor of changes in weight at 6-month follow-up



Note: SREB= baseline eating self-regulatory skills, where low SREB indicates a score≤3.6 and high SREB indicates a score>3.6. Weight changes from baseline to 6-month follow-up. Underweight indicates a BMI<18.5kg/m^2; Normal weight indicates a BMI between 18.5 to 24.9 kg/m^2 and Overweight indicates a BMI 25kg/m^2 or over. Mean weight changes adjusted for age, gender, ethnicity and height changes.

Figure 2 Interaction between ethnicity and baseline eating self-regulatory skills as a predictor of changes in weight at 6-month follow-up



Note: SREB= baseline eating self-regulatory skills, where low SREB indicates a score≤3.6 and high SREB indicates a score>3.6. Weight changes from baseline to 6-month follow-up. Mean weight changes adjusted for age, gender, baseline BMI and height changes.

3.3 Eating self-regulatory skills and likelihood of gaining or losing 5% of initial body weight at 6 months follow-up

The results for the likelihood of losing 5% of initial body weight, presented in Table 2, were not statistically significant for any of the 3 models. In line with this, the results for the likelihood of gaining 5% of initial body weight were not statistically significant for Model 1 unadjusted nor Model 2 adjusted for covariates. However, the model fit improved

significantly with the inclusion of an interaction between eating self-regulatory skills and baseline BMI ($\Delta X^2(6)=7.23$, p=0.007). Since the inclusion of interactions between SREB and socio-demographics did not improve the model fit, these were excluded from the final model. The final model (Model 3) explained from 7% to 11% of the variance in risk of substantial weight gain, correctly classifying 77% of cases. Lower eating self-regulatory skills and BMI at baseline were associated with an increased likelihood of gaining at least 5% of initial body weight ($OR_{SREB}=0.52$, p=0.006 & $OR_{BMI}=0.80$, p=0.003).

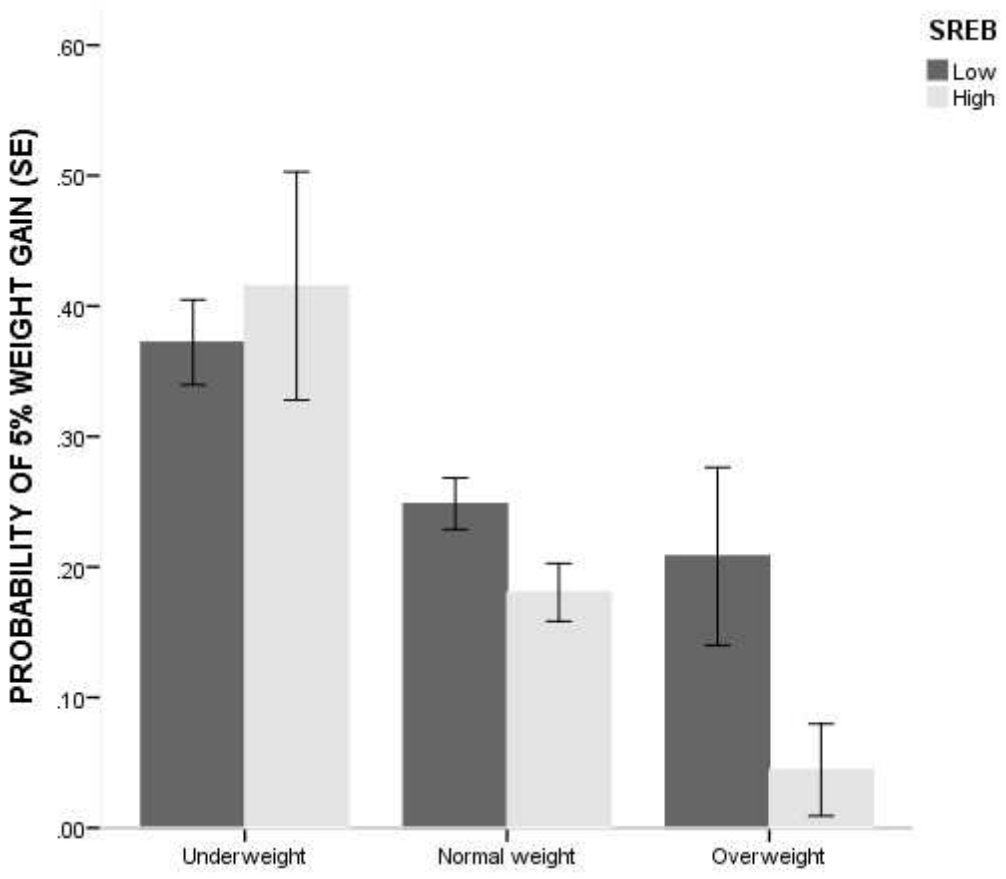
Table 2 Predictors of gaining or losing 5% of initial body weight or over at 6-month follow-up

	Model 1 Unadjusted			Model 2 Adjusted			Model 3 Adjusted		
	B(SE)	OR (95%CI)	p	B(SE)	OR (95%CI)	p	B(SE)	OR (95%CI)	p
5% Weight gain									
Constant	-1.2 (0.15)		**<0.001**	-1.2 (0.16)		**<.001**	-1.4 (.18)		**<0.001**
SREB[a]	-.39 (0.21)	.68(0.44;1.03)	0.071	-0.50 (0.22)	0.60(0.39;0.94)	0.025	-0.66 (0.24)	0.52(0.32;0.83)	**0.006**
Age				-0.04 (0.10)	0.96(0.78;1.17)	0.684	-0.04 (0.10)	0.96(0.78;1.17)	0.697
Gender[b]				0.16 (0.40)	0.85(0.38;1.88)	0.696	-0.17 (0.41)	0.84(0.37;1.9)	0.679
Ethnicity[c]				0.28 (0.33)	0.75(0.40;1.45)	0.402	-0.36 (0.34)	0.69(0.36;1.35)	0.288
Baseline BMI				-0.13 (0.06)	0.87(0.77;0.99)	0.032	-0.21 (0.07)	0.80(0.70;0.93)	**0.003**
Height changes				0.14 (0.15)	1.15(0.85;1.5)	0.365	0.13(0.16)	1.14(0.84;1.5)	0.392
BMI*SREB							-0.20 (0.07)	0.82(0.70;0.95)	**0.008**
Model fit	R^2=0.013 to 0.020 $X^2(1)$=3.290, p=0.070			R^2=0.043 to 0.064 $X^2(6)$=10.799, p=0.095 $\Delta X^2(5)$=7.509, p=0.185			R^2=0.070 to 0.11 $X^2(7)$=18.036, p=**0.012** $\Delta X^2(1)$=7.237, p=**0.007**		
5% weight loss									
Constant	-2.02 (0.19)		**<0.001**	-2.09 (0.29)		**<.001**	-2.08 (0.21)		**<0.001**
SREB[a]	.123 (0.28)	1.13(0.65;1.97)	0.664	0.24 (0.29)	1.27(0.70;2.28)	0.420	.166 (0.30)	1.18(0.65;2.15)	0.587
Age				0.05 (0.11)	1.05(0.85;1.31)	0.637	.073 (0.11)	1.07(0.86;1.34)	0.516
Gender[b]				-0.08 (0.50)	0.93(0.34;2.47)	0.873	-0.17 (0.51)	0.98(0.36;2.67)	0.973
Ethnicity[c]				0.07 (0.42)	1.07(0.47;2.47)	0.861	0.05 (0.43)	1.05(0.45;2.44)	0.911
Baseline BMI				-0.11 (0.06)	1.11(0.99;1.25)	0.060	0.16 (0.63)	1.17(1.03;1.32)	**0.012**
Height changes				-0.27 (0.24)	0.760(0.47;1.22)	0.255	-0.26(0.24)	0.77(0.48;1.23)	0.274
BMI*SREB							0.22 (0.10)	1.24(1.00;1.54)	0.042
Model fit	R^2=0.001 to 0.001 $X^2(1)$=0.189, p=0.664			R^2=0.024 to 0.046 $X^2(6)$=5.874, p=0.437 $\Delta X^2(5)$=5.87, p=0.338			R^2=0.042 to 0.081 $X^2(7)$=10.52, p=0.161 $\Delta X^2(1)$=4.64, p=0.031		

Note: [a]Eating self-regulatory skills at baseline. [b]Gender, Male=0 and Female=1. [c]Ethnicity, White=0 and other=1. R^2= 'Cox & Snell R^2' to' Nagelkerke R^2'. Mean self-regulatory skills among students who gained 5% of their initial body weight or over was 3.30 (sd=0.71). Mean eating self-regulatory skills among students who did not gain 5% the mean was 3.50 (sd=0.70). P-value of ≤0.01 was considered statistically significant.

These results also suggest that self-regulatory skills moderated the relationship between baseline BMI and 5% weight gain (OR=0.82, p=0.008). As shown in Figure 3, students with overweight (BMI≥25 kg/m^2) and normal weight (BMI between 18.5 and 24.9 kg/m^2) that had higher baseline eating self-regulatory skills (>3.6), also had lower risk of gaining at least 5% of their initial body weight over the first 6 months at university than those who had lower baseline eating self-regulatory skills.

Figure 3 Interaction between baseline BMI and baseline eating self-regulatory skills as a predictor of gaining 5% of initial body weight or over at 6-month follow-up



Note: SREB= baseline eating self-regulatory skills, where low SREB indicates a score≤3.6 and high SREB indicates a score>3.6. Underweight indicates a BMI<18.5kg/m^2; Normal weight indicates a BMI between 18.5 to 24.9 kg/m^2 and Overweight indicates a BMI 25kg/m^2 or over. Predicted probability of gaining 5% of initial body weight adjusted for age, gender, ethnicity and height changes.

3.4 Eating self-regulatory skills and dietary behaviours at 6 months follow-up

Table 3 shows the results for the logistic regressions. The interactions were not significant for any model, and therefore, only the results for the two-step models are presented. In the unadjusted model, eating self-regulatory skills at baseline significantly predicted higher FV intake (p=0.008). The inclusion of socio-demographic variables improved the model fit significantly ($\Delta X^2(4)=18.907$, p=0.001), and this final model explained from 9% to 14% of the variance in FV intake and classified 66% of the cases correctly. Greater baseline eating self-regulatory skills (OR=1.8, p=0.007) and being female (OR=4.3, p=0.002) were associated with an increased likelihood of maintaining or achieving a higher consumption of FV at 6 months follow-up.

With respect to the logistic regression model for maintaining or achieving a low consumption of SSS, the unadjusted model showed that eating self-regulatory skills was a significant predictor (OR=1.9, p=0.001). Although the inclusion of socio-demographic variables did not significantly improve the model fit ($\Delta X^2(4)=1.035$, p=.904), the likelihood ratio test increased. Model 2 explained from 4.8% to 6.5% of the variance in SSS intake and correctly classified 62% of the cases. The results indicated that higher baseline levels for eating self-regulatory skills was related to a greater likelihood of maintaining or achieving a lower consumption of SSS over 6 months. None of the covariates were found to be related to the outcome.

Finally, the results for the unadjusted model for a low SD intake at 6-month follow-up indicated that greater eating self-regulation was related to an increased chance of maintaining or achieving a low SD intake (OR=1.45, p=.041), however this did not reach the stringent cut-off for significance established for this study ($p \leq .01$). The inclusion of covariates (Model 2) did not improve the model fit ($\Delta X^2(4)=6.935$, p=.139). The model explained from 4.4% to 5.8% of the variance in SD intake and classified 59% of cases correctly.

Table 3 Predictors of maintaining or achieving a healthier dietary intake at 6-month follow-up

	Maintained or achieved healthier dietary behaviours					
	Model 1 Unadjusted			Model 2 Adjusted		
	B(SE)	OR (95%CI)	p	B(SE)	OR (95%CI)	p
High F&V intake[a]						
Constant	-0.79 (.14)		**<0.001**	-.987 (.16)		**<.001**
SREB[d]	0.54 (.20)	1.71 (1.1; 2.5)	**.008**	.59 (.22)	1.8 (1.1; 2.7)	**.007**
Age				-.19 (.10)	.82 (.66; 1.0)	.060
Gender[e]				1.4 (.47)	4.3 (1.7; 10.9)	**.002**
Ethnicity[f]				-.57 (.31)	.56 (.30; 1.0)	.066
BMI baseline				.03 (.05)	1.0 (.93; 1.13)	.511
Model fit		R^2=.029 to .041 $X^2(1)$=7.402, p=.007			R^2=.09 to .14 $X^2(5)$=26.308, p<**.001** $\Delta X^2(4)$=18.907, p=**.001**	
Low SSS intake[b]						
Constant	-.43 (.13)		**.001**	-.43 (.13)		**.001**
SREB[d]	.64 (.19)	1.9 (1.2; 2.7)	**.001**	.64 (.20)	1.9 (1.3; 2.8)	**.001**
Age				-.05 (.08)	.95 (.80; 1.1)	.551
Gender[e]				-.24 (.34)	.78 (.40; 1.5)	.479
Ethnicity[f]				-.09 (.28)	.91 (.52; 1.6)	.737
BMI baseline				.01 (.04)	1.0 (.93; 1.1)	.789
Model fit		R^2=.044 to .059 $X^2(1)$=11.307, p=**.001**			R^2=.048 to .065 $X^2(5)$=12.343, p=.030 $\Delta X^2(4)$=1.035, p=.904	
Low SD intake[c]						
Constant	.19 (.13)		.140	1.44 (.13)		.275
SREB[d]	.37 (.18)	1.45 (1.0; 2.1)	.041	.36 (.18)	1.4 (.99; 2.01)	.053
Age				.03 (.08)	1.0 (.88; 1.2)	.688
Gender[e]				.80 (.34)	2.2 (1.1; 4.3)	.017
Ethnicity[f]				-.15 (.27)	.86 (.50; 1.5)	.581
BMI baseline				-.02 (.04)	.98 (.90; 1.0)	.685
Model fit		R^2=.017 to .023 $X^2(1)$=4.291, p=.038			R^2=.044 to .058 $X^2(5)$=11.226, p=.047 $\Delta X^2(4)$=6.935, p=.139	

Note: [a]Maintaining or achieving a consumption at least 2.25 servings of fruit and vegetable per day. [b]Maintaining or achieving a consumption of a maximum of 0.36 occasions of sweet and salty snacks per week. [c]Maintaining or achieving a consumption of a maximum of 0.1 occasions of sugary drinks per week. [d]Eating self-regulatory skills at baseline. [e]Gender – Male=0 and Female=1. [f]Ethnicity – White=0 and Other=1. R^2= 'Cox & Snell R^2' to' Nagelkerke R^2'. P-value of ≤0.01 was considered statistically significant.

4. Discussion

This is the first study to assess eating self-regulatory abilities using a valid scale and to examine the impact of self-regulation on weight gain and healthy dietary behaviours among first year undergraduate students. As hypothesised, students who entered university with higher eating self-regulatory skills were more likely to maintain or achieve a healthier diet over the course of the first 6 months in university. Additionally, higher eating self-regulatory skills were related to decreases in weight and lower likelihood of gaining a substantial amount of weight among students with overweight.

Although weight gain (0.6 kg) was modest, around a quarter of the students gained a substantial amount of weight. This is in line with a recent study in which 301 first year students in London were weighed and measured over 7 months and found a weight gain of 0.54 kg, and that one in five gained at least 5% of their initial body weight (Meisel, Beeken, van Jaarsveld, & Wardle, 2015). However, this still conflicts with results from other studies (Vella-Zarb & Elgar, 2009) and there is also little consistency around whether weight gain is related to a lower or higher baseline BMI in first year students (Finlayson, Cecil, Higgs, Hill, & Hetherington, 2012; Mihalopoulos, Auinger, & Klein, 2008; Vella-Zarb & Elgar, 2009). According to a recent study, a potential explanation for these inconsistencies is the fact that baseline BMI appears to interact with other factors in order to promote weight gain (Boyce & Kuijer, 2015). This is in line with findings from the present study, which showed that higher eating self-regulatory skills protected against substantial weight gain among students with overweight and normal weight. On the other hand, students with underweight gained weight regardless of their level of eating self-regulatory skills.

However, it is important to note that weight gain in the underweight and normal weight group could represent a positive outcome. On the other hand, weight gain could also represent a negative outcome for those with a BMI on the borderline of normal weight/overweight or for

those with overweight and obesity. Therefore, the prevention of weight gain in this group is particularly relevant, since people with higher BMIs may be more genetically predisposed to gain weight in an obesogenic environment (Kautiainen, Rimpela, Vikat, & Virtanen, 2002; Wardle & Boniface, 2008). Self-regulation is therefore a potential target for interventions seeking to prevent substantial weight gain among people predisposed to obesity.

Although no effect of self-regulation on the likelihood of losing at least 5% of initial body weight was found, the results for weight gain suggest that higher eating self-regulatory skills are related to lower likelihood of 5% weight gain in individuals with overweight and normal weight. Further studies should explore this in samples that include more participants affected by overweight and obesity. It is possible among people with normal weight, lower likelihood of 5% weight gain may have occurred as a consequence of factors other than the capacity to regulate eating behaviours. Studies have suggested that eating disorders may affect 8 to 49% of undergraduate students (Lipson & Sonneville, 2017; Eisenberg, Nicklett, Roeder, & Kirz, 2011; Prouty, Protinsky, & Canady, 2002). These disorders usually involve symptoms such as concern about body image, body image distortion and worrying about losing control over their eating (Eisenberg, Nicklett, Roeder, & Kirz, 2011). This group of people tend to present rigid control over their eating, rather than flexible control. The latter is more representative of the ability to self-regulate eating behaviours (Johnson, Pratt, & Wardle, 2012) and may explain why self-regulation was not found to be a predictor of weight loss among those with lower BMIs.

Previous studies have shown that ethnicity does not predict weight changes (Gillen & Lefkowitz, 2011; Roane et al., 2015), and this was also the case in the present study. However, a significant moderating effect of eating self-regulatory skills on the relationship between ethnicity and weight changes was found. White students who had lower eating self-regulatory skills experienced greater increases in their weight compared to those with higher

eating self-regulatory skills, while a smaller effect was found for people classified as 'other ethnicities'. A previous study found that white female students tend to be more concerned about gaining weight during the first year of university than black students (Webb et al., 2013). It is possible, therefore, that white students tend to apply more self-regulatory skills to control their weight and their capability may reflect their level of success.

With respect to dietary behaviours, the level of eating self-regulatory skills at baseline was related to higher baseline FV intake and lower baseline SSS and SD intake, in line with results found in a cross-sectional study with UK adults (Kliemann, Beeken, Wardle, & Johnson, 2016). As anticipated, higher baseline eating self-regulatory skills also predicted higher FV and low SSS intake at 6-month follow-up. Although lower SD intake was also related to higher eating self-regulatory skills, it did not reach the significance established for this study. However, this study only assessed differences in the frequency of SD intake. A systematic review has suggested that sugary drinks tend to be consumed in large portion sizes, due to their lower satiety effect compared to solid foods of the same energy density (Malik, Schulze, & Hu, 2006). Therefore, future studies should explore the effect of eating self-regulatory skills on the amount of sugary drinks consumed.

This study had limitations. For convenience, only students from universities based in London were included. As a consequence, the sample may not be representative of UK first year students, because London tends to have a lower percentage of students with overweight and obesity compared to other regions of the UK (Public Health England, 2015). In fact, individuals with overweight and obesity were under-represented in the sample, which may explain the modest weight gain found in this study. Men were also under-represented, suggesting that the participants who decided to take part in the study may differ from the general student population regarding their interest in a healthy diet and weight control.

441 The use of self-report measures to assess dietary intake is also a limitation. Although the FV
442 measure has been validated (Cappuccio et al., 2003), the SSS and SD measures have not,
443 although they have been used in several previous studies (Croker, Lucas, & Wardle, 2012;
444 Kliemann, Beeken, Wardle, & Johnson 2016; McGowan, Croker, Wardle, & Cooke, 2012).
445 In order to promote high retention rates, the online surveys were kept short and only four
446 questions on food frequency were included. However, they lacked portion size information,
447 were related to groups of foods rather than specific foods, and responses options ranged from
448 1 to 7. Also, as a retrospective measure, this food frequency questionnaire is also limited in
449 that it relies on individuals' memory. However, its unannounced and self-administered
450 features as well as the fact that it captures habitual behaviours are important strengths of this
451 method (Walton, 2015). Additionally, previous studies using these questions have shown that
452 they can provide valid data on habitual dietary intake (Kliemann, Beeken, Wardle, &
453 Johnson, 2016; McGowan et al., 2013).

454 Although there are still several aspects about the susceptibility to weight gain among first
455 year undergraduate students that need to be further investigated, this study provides some
456 initial evidence for the role of eating self-regulatory skills in protecting students against
457 substantial weight gain and unhealthy dietary changes. There is some evidence that
458 interventions using goal-setting, planning, self-monitoring and feedback on performance
459 techniques may potentially promote self-regulatory skills and weight loss among adults with
460 overweight and obesity (Annesi, Johnson, Tennant, Porter, & McEwen, 2016; Crane, Ward,
461 Lutes, Bowling, & Tate, 2016; Kolodziejczyk et al., 2016; Norman, Kolodziejczyk, Adams,
462 Patrick, & Marshall, 2013). Also, a recent study showed that habit-based interventions
463 promoting the repetition of target behaviours in a consistent context hold promise for
464 enhancing self-regulatory skills among adults with obesity (Kliemann et al., 2017). Habit-
465 based interventions are of particular interest because they are considered to be scalable, and

are designed to promote lasting behaviour changes. Future studies should investigate whether these techniques may also enhance self-regulatory skills among undergraduate students and the effect of improving these skills on their weight and diet over the course of their studies at university. Additionally, future powered studies should further investigate the potential impact of ethnicity on the relationship between self-regulation and weight changes, exploring this relationship in different ethnic groups.

5. Conclusions

This study provides evidence that higher baseline eating self-regulatory skills may help students to maintain or achieve a healthy diet and protect them against substantial weight gain, especially among students with overweight. Weight gain prevention initiatives that include eating self-regulatory skills training should be tested among individuals with overweight or predisposed to overweight and obesity.

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Table S1 Sample characteristics at baseline

Variable	Cut-off point	Baseline (N=481)		Completers (N=262)		Non-completers (N=219)		Statistic[¥]
		N	% or Mean(sd)	N	% or Mean(sd)	N	% or Mean(sd)	
Gender								
Female	-	368	76.5	212	80.9	156	71.2	$\chi^2(1)=6.22$, p=**.01**
Age in years								
Mean (sd)	-	481	19(1.65)	300	19(1.7)	219	18.9(1.6)	Mann Whitney p=.632
Ethnic group								
White	-	287	59.7	170	64.9	117	53.4	$\chi^2(4)=12.53$, p=**.012**
Black	-	12	2.5	4	1.5	8	3.7	
Asian	-	119	24.7	52	19.8	67	30.6	
Mixed	-	39	8.1	25	9.5	14	6.4	
Other[a]	-	24	5.0	11	4.2	13	5.9	
Living arrangement								
University/College halls	-	340	70.7	192	73.3	148	67.6	$\chi^2(2)=2.480$, p=.302
Living with parents	-	61	12.7	28	10.7	33	15.1	
Renting/ owing their home[b]	-	80	16.6	42	16.0	38	17.4	
Universities by region								
North London	-	13	2.7	9	3.4	4	1.8	$\chi^2(4)=7.135$, p=.126
Central London	-	402	83.6	226	86.3	176	80.4	
South London	-	45	9.4	19	7.3	26	11.9	
East London	-	11	2.1	5	1.9	6	2.7	
West London	-	10	2.3	3	1.1	7	3.2	
Weight at baseline								
Mean (sd)	-	478	60.4(10.6)	298	60.2(10.3)	218	60.7(11.1)	t(449.3)=-.56, p=.579
Weight status[c]								
Underweight[c]	<18,5	73	15.2	34	13.0	39	17.8	$X^2(2)=2.93$, p=.233
Normal weight[d]	18.5-24.9	353	73.4	200	76.3	153	69.9	
Overweight and obese[e]	*≥25*	52	10.8	26	10.0	26	11.8	
BMI at baseline								
Mean (sd)	-	478	21.3(3.1)	298	21.3(3.2)	218	21.3(3.0)	t(476)=.023 p=.982
Low	*≤21.3*	266	55.6	153	58.8	113	51.8	$X^2(1)=2.362$, p=.139
High	>21.3	212	44.4	107	41.2	105	48.2	
Fruit and Vegetable[d]								
Mean (sd)	-	481	1.6(1.0)	300	1.61(1.0)	219	1.50 (.99)	t(479)=-1.19 p=.234
Low	*≤2.25*	359	74.6	190	72.5	169	77.2	$X^2(1)=1.362$, p=.249
High	>2.25	122	25.4	72	27.5	50	22.8	
Sweet/ salty snacks[e]								
Mean (sd)	-	481	.70(.6)	300	.70(.69)	219	.70(.60)	t(479)=-.134 p=.893
Low	*≤0.36*	240	49.9	136	51.9	104	47.5	$X^2(1)=.932$, p=.360
High	>0.36	241	50.1	126	48.1	115	52.5	
Sugary drinks[e]								
Mean (sd)	-	481	.32(.5)	300	.28 (.53)	219	.37 (.59)	Mann Whitney p=.020
Low	*≤0.1*	212	44.1	127	48.5	85	38.8	$X^2(1)=4.516$, p=.035
High	>0.1	269	55.9	135	51.5	134	61.2	
Alcoholic drinks[e]								
Mean (sd)	-	481	.27(.4)	300	.25 (.38)	219	.29 (.45)	t(479)=1.03 p=.302
Low	*≤0.1*	193	40.1	105	40.1	88	40.2	$X^2(1)=.001$, p=.981
High	>0.1	288	59.9	157	59.9	131	59.8	
Self-regulation[f]								
Mean (sd)	-	466	3.44(.68)	254	3.44(.70)	212	3.45(.66)	t(464)=.068 p=.956
Low	≤3.6	285	61.2	155	61.0	130	61.3	$X^2(1)=.004$, p=.948
High	>3.6	181	38.8	99	39.0	82	38.7	

Note: [a]Black, Asian, Mixed or other ethnicity. [b]Renting privately or renting from local authority/housing associations or owing their own home. [c]Weight status according to BMI (kg/m^2). [d]Servings per day at baseline. [e]Occasions of consumption per day at baseline. [f]Score for eating self-regulatory skills ranged from 1 to 5. [¥]Baseline differences between completers and non-completers. sd=Standard Deviation.

679 **Table S2** Correlations between weight, BMI, dietary intake, socio-demographic characteristics and eating self-regulatory skills at baseline

Baseline data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1 SREB[a]												
2 Weight	-.11											
3 BMI	**-.14***	**.80***										
4 Fruit & Vegetables[b]	**.30***	**-.12***	-.10									
5 Sweet/Salty Snacks[c]	**-.34***	-.07	-.04	.01								
6 Sugary Drinks[d]	**-.22***	.04	.06	**-.15***	**.27***							
7 Age	.03	**.13***	**.20***	-.09	-.04	-.02						
8 Gender[e]	-.06	**-.50***	**-.13***	**.17***	.06	**-.13***	-.02					
9 Ethnic origin[f]	-.06	-.09	-.01	**-.16***	-.02	.09	-.01	-.05				
10 College halls[g]	.04	-.01	-.04	.06	-.05	-.02	-.**19***	-.03	-.08			
11 Living with parents[h]	-.02	-.09	-.02	.01	.04	-.02	-.02	.02	**.16***	**-.60***		
12 Renting/own home[i]	-.03	.07	.06	-.09	.02	.04	**.25***	.02	**-**.04	**-.69***	**-.17***	

680 **Note=** [a]Eating self-regulatory skills, score range from 1 to 5**.** [b]Servings of fruit and vegetables per day. [c]Occasions of sweet and salty snack consumption per day. [d]Occasions
681 of sugary drinks consumption per day. [e]Gender, Male=0 and Female=1. [f]Ethnicity, White=0 and Other=1. [g]College/University halls, No=0 and Yes=1. [h]Living with parents,
682 No=0 and Yes=1. [i]Renting or owing their home, No=0 and Yes=1. 2-tailed p-value. *p<0.01.

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