A SELF-HELP WEIGHT-MANAGEMENT MANUAL LIMITS WEIGHT GAIN IN FIRST-YEAR FEMALE STUDENTS LIVING IN UNIVERSITY RESIDENCES

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ABSTRACT

This study aimed to evaluate the efficacy of a self-help weight-management manual in restricting weight gain in first-year female students (FYFS) in a controlled intervention. Four out of 12 residences on the Stellenbosch campus of Stellenbosch University were selected for the intervention group (baseline n=191, final follow-up n=95); and three for the control group (baseline n=169, final follow-up n=78) (cluster sampling). The intervention was a self-help weight-management manual. Differences in weight change (primary outcome) at three and eight months between groups was estimated using a linear mixed-effect regression model adjusting for baseline BMI. Multiple imputations were done for weight at each time point using regression models based on baseline weight, height, BMI, MUAC, triceps skinfold and middle and hip circumferences. Both groups had gained a similar amount of weight after 3 months. Weight gain continued in the control group, but plateaued in the intervention group, culminating in 0.9kg (95% CI: 0.1 to 1.7kg) (p=0.036) less weight gained at final follow-up than the control group. A low-intensity intervention (self-help manual) may thus be a feasible, potentially successful method to limit weight gain in FYFS.

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INTRODUCTION

Research among adults shows that unintended weight gain can occur at any age, but young adults are at particular risk, especially women (Williamson et al. 1990; Gow, Trace & Mazzeo 2010; Poobalen et al. 2010; Bertz, Pacanowski & Levitsky 2015; Swanson 2016). This trend is reflected in results of the 2016 South African Demographic and Health Survey, indicating that overweight/obesity was present in 27% of female adolescents (15-19 years), while it was

52.8% in the 20-24 year-olds (National Department of Health et al. 2016). It has further been documented that female students at tertiary institutions are a group at increased risk of weight gain (Senekal, Albertse & Steyn 1988; Levitsky, Halbmaier & Mrdjenovic 2004; Fedewa et al. 2014, Kelly & Latner 2015). Levitsky et al. 2004 emphasize that weight gain experienced by students is considerably greater than that observed in the general population. Research during the 1980s at a South African university showed that 59% of female students retrospectively reported that they had gained weight, ranging from 1-25 kg, during their first year (Senekal et al. 1988), while a prospective study conducted in the 1990s found that 72% of first-year female students (FYFS) gained between 2-13 kg within the first three months at university (Senekal 1994). Interestingly, research by Webb et al. (2013) showed that although 90% of their sample of FYFS believed that first-year weight gain occurs, only 12% expected they would experience weight gain.

There seems to be general agreement that the transition from home to university may explain the phenomenon of weight gain by students (Anderson, Shapiro & Lundgren 2003; Levitsky et al. 2004; Gow et al. 2010; Fedewa et al. 2014, Kelly & Latner 2015. Gillen and Lefkowitz (2011) propose that this transition signifies the first time of independence for many students, during which they make their own decisions about eating, physical activity and other factors that may increase their risk for weight gain. Changes in lifestyle that may increase weight gain include transition to a more sedentary lifestyle, exposure to more social eating occasions, greater access to cafeteria and fast-food meals, increased meal frequency, consumption of snacks and social drinking, involvement in campus groups and reduced sleep (Senekal 1994, Anderson et al. 2003; Levitsky et al. 2004; Dyson & Renk 2006; Holm-Denoma et al. 2008; Gillen & Lefkowitz 2011). Finlayson et al. (2012) reported that disinhibition, binging and opportunistic eating, as well as a tendency to overconsume, may also increase risk, as these indicators were associated with increased fat mass in first-year students.

Anderson et al. (2003) emphasize that once body fat has been accumulated, it is difficult to lose; also that behaviours established during this critical period shape lifestyle choices. Young adulthood is a critical time period for establishing healthy behaviours (Fedewa et al. 2014; Swanson 2016). Prevention initiatives targeted at this age group may reduce systematic weight gain and the risk of obesity in later adulthood.

A number of researchers have indicated that universities need to take some responsibility for engagement with students on concerns they may have about weight gain during their first year on campus (Gillen & Lefkowitz 2011; Webb et al. 2013; Das & Evans 2014; Vadeboncoeur, Foster & Townsend 2016). The university environment provides a unique setting for weight management interventions because of the prevailing educational mission and variety of resources available to students (Fedewa et al. 2014). Das and Evans (2014) propose that students want institutions to assist them with managing their physical activity and nutrition behaviours. Swanson (2016) also noted that college students desire and require assistance for successful weight management.

Challenges inherent to weight gain prevention interventions targeted at FYFS include the need to reach large numbers of students in a short period of time during their first weeks on campus. Students are expected to participate in numerous activities as part of finalizing registration, accommodation and introduction to the university. A self-help intervention is a viable option under these circumstances, as students could engage with the intervention at their leisure. Latner (2001:88) maintains that “self-help has the additional advantage of helping individuals to obtain a sense of power and the inward resources that give them more control over themselves and their environment. Empowerment, in turn, may increase self-efficacy, self-esteem and the sense that one’s own efforts can effect positive change.”

The aim of this study was to evaluate the efficacy of a self-help weight-management manual in limiting weight gain in FYFS living in residences at Stellenbosch University.

METHODS

The study involved a controlled intervention with purposively selected intervention and control groups. Baseline data were obtained over a three-week period during the students' first month at university. Follow-up evaluations took place three months and eight months after baseline. Weight (kg) was the primary outcome measure to assess the intervention effect in terms of limiting weight gain.

The study population consisted of all FYFS (n=883) living in 12 residences on the Stellenbosch campus of Stellenbosch University at the time of the study (2003). Students with a self-identified active eating disorder were not eligible for participation, although they could choose to receive the intervention. The sampling aim was to include at least a third of the total study population of 883 students, thus approximately 300 in total, with 150 in the experimental and 150 in the control groups. A cluster sampling technique was used with each residence forming a cluster. Residences were added to either the control (total of four) or intervention (total of 3) groups considering the average number of first year students allocated to each residence during the previous two academic years, as well as geographical separation to decrease the possibility of intervention contamination.

Power calculation conducted using the Open-Epi calculator (mean difference option), showed that this sample would allow for the detection of a 1kg difference in weight at a power of 80% and a significance level of 5%, assuming a standard deviation in weight change of 3kg in both groups. The values used in the calculation were derived from relevant published works: weight change experienced over a three month period by FYFS allocated to four groups reported by (Senekal 1987): 0.2±1.7kg (students who gained less than 2kg), 2.4±kg (students who gained 2-2.9kg), 4±3.6kg (students who gained 3-4.9kg) and 6.6±1.8kg (students who gained 5kg or more); Bertz et al. (2016) reported a weight loss of -0.19±2.89kg for first-year students exposed to a self-weighing intervention for prevention of weight gain versus the gain of 0.64±3.6kg in the control group after 6 months; and Gow et al. (2009) reported a weight loss of -0.12±2.92 in first-year students in an internet-combined-feedback intervention for prevention of weight gain versus the gain of 1.04±3.5kg in the control group after 6 weeks.

All FYFS in each of the selected residences were invited to participate in the study during a 30 to 45 minute information session held in each residence. The final baseline sample included n=192 students in the intervention residences (64% of the available 298) and n=169 students in the control residences (80% of the available 211).

The intervention involved a biographic self-help weight-management manual. The development of the manual included a formative assessment of the weight management problems and associated factors in a four-year follow-up of a cohort of FYFS (Senekal 1994). In developing the manual, content formative findings were considered within the context of key concepts embedded in the Social Cognitive Theory (SCT) of behaviour change, which suggests that behaviour is influenced reciprocally by intrapersonal factors and the physical and social environments (Baranowski et al. 2003). These concepts include intention, tailoring, self-efficacy, motivation, barriers and facilitators and socio-ecological influences (Patrick et al. 2014) (Table 1). Specific considerations in the development of the intervention were intrapersonal factors (cognitive and affective processes), biological events and self-efficacy, interpersonal processes among students and significant others in their environment, as well as institutional and community level factors such as the university environment as such, as outlined in the socio-ecological health promotion model (McLeroy et al. 1988). The chapters in the manual include narrative sections on core concepts in English, self-assessment checklists for identification of behaviour change needs and a selection of tailored intervention actions.

The manual was introduced to the intervention group at baseline using a Power-Point presentation on weight problems experienced by female students. The control group was exposed to a PowerPoint presentation on the association between weight status and the risk for development of chronic lifestyle-related diseases. The control group did not receive the

TABLE 1: OUTLINE OF THE WEIGHT-MANAGEMENT INTERVENTION STRUCTURE AND CONTENT WITHIN THE CONTEXT OF THE SOCIAL COGNITIVE THEORY OF BEHAVIOUR (SCT)

SCT related concept	Strategies	Chapters (CH)[a] in the manual that address SCT concepts
A. Intention formation	To provide insights into: • Female body stereotypes • Weight dynamics, weight gain and determinants • Vulnerability of FYFS to weight gain • Potential to prevent or address these problems	CH 1. *Women and body shape obsessions* CH 2. *Weight balance – nature vs nurture* CH 3. *Becoming an effective weight manager* Ch 5. *More about keeping your weight stable* CH 6. *More about weight loss and diets* CH 7. *More about weight maintenance after weight loss* CH 8. *More about preventing further weight gain*
B. Tailoring	To provide insights into identification of a reasonable personal weight goal To promote self-assessment of weight management-related core behaviours, characteristics and skills; planning of behaviour change action plans accordingly	CH 3. *Becoming an effective weight manager* CH 4. *Defining your reasonable weight goal*
C. Self-efficacy	• To focus on • Goal setting skills training • Problem solving • Ensuring underlying knowledge, self-insights and skills • Positive role models	CH 10: *Writing goals – the effort is worth it* CH 11: *Healthy eating* CH 12: *Healthy eating-let's get practical* CH 13: *Be active!* CH 14: *Self-concept – who are you in your mind's eye?* CH 15: *Body image – the mind mirror* CH 16: *Stress management* CH 17: *Communication –the key to positive interaction*
D. Motivation	To provide insights in motivation for weight management; To foster development and maintenance of motivation	CH 9. *Self-motivation* – the heart of the matter High levels of self-efficacy contributes to motivation
E. Barriers and facilitators	To create awareness and promote development of skills to manage weight management barriers and promote facilitators	Barriers and facilitators are covered, self-assessed and addressed in the chapters mentioned under self-efficacy
F. Social-ecological support	To create awareness of various environmental influences specific to FYFS that impact on weight management capacity	CH 18: *Manage your environment*
G. Specific behaviour change skills/tools	To provide insights in core behaviour change actions e.g. behaviour chains, functional thinking and positive self-talk, visualization and self-monitoring	Full chapter CH 19: *The weight-management toolbox*

[a]Chapter titles are listed

intervention manual at the conclusion of the study; this was not a requirement at the time of the study. The only further contact made with either group involved Follow-up 1 and Follow-up 2 assessments. All students who participated in baseline assessments received notices to attend Follow-up 2, irrespective of whether they had attended Follow-up 1.

A self-administered questionnaire was used to collect information on age, home language, and occupation (scholar or other) and domicile in the year prior to the study. Anthropometric measures were taken by fieldworkers trained according to the standards of the International Society for Advancement of Kinanthropometry. Weight was measured in light clothing without shoes using a SECA Balance beam scale to the nearest 0.1 kg. Height, without shoes, was measured to the nearest 0.1 cm with a SECA 212 Leicester stadiometer. Assessments were conducted in a private venue in each of the residences. Body mass index (BMI) was computed as weight in kg/height (m)2 and categorized according to the World Health Organization (WHO) guidelines, namely BMI<18.5 = underweight; BMI ³18.5 and <25 = normal; BMI ³25 and <30 = overweight and a

BMI³30 = obese (World Health Organization 2000). Mid-upper arm circumference (MUAC) was taken to the nearest 0.1cm using a non-stretch measuring tape at the level of the mid-acromiale-radiale and perpendicular to the long axis of the arm. Triceps skinfold was taken to the nearest 0.2 mm using a Harpenden skinfold caliper at the midpoint between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna of the right arm, with the arm hanging loosely at the side of the body and the palm facing anteriorly. Waist circumference was taken at the level of the narrowest point between the lower rib border and the iliac crest after normal expiration. Hip circumference was taken at the level of the greatest posterior protuberance of the buttocks. Circumference measures were taken to the nearest 0.1cm using a non-stretch measuring tape. Questionnaires were completed in a central venue, while anthropometric measures were taken in a secluded area.

Comparisons of baseline socio-demographic variables between intervention and control groups were conducted using the Pearson Chi-Square test and the independent samples t-test. A linear mixed effects regression model was used to test for baseline differences in anthropometric measures between the two groups to account for dependence (clustering) of participants from a residence. A linear mixed-effect regression model with fixed effects group, time, group by time interaction and baseline BMI and residence as random effect was used to estimate the intervention effect (intention to treat). Multiple imputations were done for weight at each time point using chained regression models based on baseline weight, height, BMI, triceps skinfold and middle and hip circumferences. Within group changes in BMI, MUAC, triceps skinfold and waist and hip circumferences over time was analysed using one-way ANOVA and Bonferroni post-hoc tests (completers only). Between group differences for these variables at each time point was tested using the independent sample t-test. The Pearson's Chi-square test was used to compare BMI classification between intervention and control groups at each time point. Comparison of anthropometric variables at baseline between those lost to follow-up (LTFU) and completers in both groups were conducted using the independent samples t-test. Statistical analyses were conducted using R and $p<0.05$ was designated as statistically significant.

Ethical approval was obtained from the Ethics Committee of the Faculty of Natural Sciences, Stellenbosch University. Fieldworkers obtained written informed consent from each participant in the presence of two witnesses, who also signed the form. Permission to conduct the study was obtained from the university authorities.

RESULTS

There were no differences between the intervention (Int) and control groups (C) for baseline socio-demographic variables. In both groups the first language of the majority of students was Afrikaans (Int=86.3%; C=75.6%), and they had been in school (Int=93.7%; C=94.9%) and resided with their parents (Int=73.1%; C=86.3%) in the year prior to the study. The mean±SD age of the intervention group was 18.7±0.35 and 18.6±0.42 for the control group.

Mean baseline weight (Table 2), height, MUAC and triceps skinfold did not differ between intervention and control groups (Table 3). Both waist and hip circumferences were significantly lower in the intervention group at baseline (Table 3). There was no significant differences between the intervention and control groups for any of the anthropometric variables at Follow-up 1, while the BMI and waist circumference was significantly lower in the intervention group compared to the control group at Follow-up 2. Triceps skinfold and waist and hip circumferences increased significantly in the intervention group, but not in the control group (completers only). There were no significant within-group changes over time for BMI and MUAC.

There was a significant difference in the weight change between the two groups over the eight months (p=0.047). The weight gain at the three month time point was similar in the two groups and the estimated intervention effect was -0.08

TABLE 2: OBSERVED AND MODEL BASED PREDICTED MEANS FOR WEIGHT[(a)] AT BASELINE, FOLLOW-UP 1 AND 2, AND ESTIMATED WEIGHT DIFFERENCE

Weight (kg)								
	Baseline		Follow-up 1 (three months)			Follow-up 2 (eight months)		
	n	Mean (SD)	n	Mean (SD)	Predicted mean[b] (95% CI)	n	Mean (SD)	Predicted mean[b] (95%CI)
Control	169	60.6 (8.9)	136	62.8 (9.7)	62.2 (61.6- 63.5)	78	63.8 (9.6)	62.8 (61.9-64.3)
Intervention	191	60.3 (8.0)	143	61.8 (8.1)	62.1 (59.8-64.4)	95	61.2 (8.2)	61.9 (59.7-64.0)
Estimated weight difference (kg) (95% CI)					-0.08 (-0.70-0.53)			-0.87 (-1.68- -0.06)
P value		0.714[(c)]			0.749[(d)]			0.036[(d)]

[(a)] Primary outcome variable
[(b)] Predicted mean weight from linear mixed effects model with BMI=21.78, the study mean at baseline
[(c)] P value for linear mixed effects regression model to test for baseline differences
[(d)] Linear mixed effect regression model with fixed effects group, time, group by time interaction and baseline BMI and residence as random effect

TABLE 3: BETWEEN GROUP DIFFERENCES IN MEAN±SD OF ANTHROPOMETRIC VARIABLES AT EACH TIME POINT, AS WELL AS THE WITHIN CHANGE OVER TIME

Group:		Full baseline Sample[a]	Between group differences at[b]…			Within group
			Baseline completers	Follow-up 1	Follow-up 2	Change
		C: n=169 Int: n=191	C: n=78; Int: n=95	C: n=71; Int: n=81	C: n=78; Int: n=95	P-value[c]
BMI	Control	21.9±2.5	22.1±2.5	22.7±2.7	23.0±2.7	0.098
	Intervention	21.7±2.5	21.4±2.4	22.1±2.4	22.0±2.6	0.115
		p=0.421	p=0.078	p=0.158	**p=0.018**	
Height[d]	Control	1.662±0.065	1.665±0.067	-	-	-
	Intervention	1.666±0.064	1.667±0.065	-	-	-
		p=0.421	p=0.784			
MUAC	Control	27.0±2.7	27.1±2.6	27.2±2.6	27.3±2.8	0.884
	Intervention	26.6±2.6	26.3±2.6	26.9±2.5	26.6±2.5	0.370
		p=0.170	**p=0.046**	p=0.415	p=0.091	
Triceps	Control	19.6±6.0	19.6±5.7	21.7±6.0	21.2±5.7	0.062
	Intervention	19.5±5.6	18.6±5.5*	21.2±6.3§	19.7±6.0*,§	**0.018**
		p=0.960	p=0.271	p=0.580	p=0.111	
WC	Control	71.1±6.4	71.1±6.7	71.7±6.8	72.4±7.2	0.505
	Intervention	68.6±6.1	67.7±5.7*	70.5±6.0§	69.9±5.4§	**0.003**
		p=0.013	**p=0.000**	p=0.279	**p=0.011**	
HC	Control	99.1±7.1	99.1±6.5	99.2±6.1	100.3±6.3	0.458
	Intervention	96.6±6.5	96.0±6.4*	98.4±6.2§	98.8±6.5§	**0.005**
		p=0.016	**p=0.002**	p=0.410	p=0.149	

[a]Linear mixed effects model to account for dependence (clustering) of participants from a residence to test for differences between the 2 groups at baseline using the full sample
[b]Independent sample t-test to calculate difference between the completers in both groups at baseline, follow-up 1 and 2.
[c]One-way ANOVA for the within-group change overtime, means with the same symbol do not differ significantly using Bonferroni post-hoc tests
[d]Height was not measured at Follow-up-1 and Follow-up-2
C: Control group; Int: Intervention group; MUAC: Mid-upper-arm circumference; WC: Waist circumference; HC: Hip circumference.

TABLE 4: BMI CLASSIFICATION OF FYFS IN THE INTERVENTION AND CONTROL GROUPS AT EACH TIME POINT (COLUMN %)[a]

BMI category	Baseline		Follow-up 1		Follow-up 2	
	C	Int	C	Int	C	Int
	n=78	n=95	n=71	n=81	n=78	n=95
<18.5	3.8	7.4	0	4.9	1.3	6.3
18.5-24.9	83.3	84.2	84.5	81.5	78.2	78.9
25-29.9	11.5	8.4	14.1	13.6	19.2	13.7
≥30	1.3	0	1.4	0	1.3	1.1

FYFS: First year female students; Int: Intervention group; C: Control group
aNo significant differences in distribution between the intervention and control groups at any time point (Pearson Chi-Square test)

kg (95% CI: -0.70 to 0.53)(p=0.749) (Table 2). Eight months after baseline, the weight gain had continued in the control group, while it had plateaued in the intervention group, with the estimated intervention effect of -0.87kg (95% CI: -1.68 to -0.06) (p=0.036) (Table 2).

There were no differences in BMI classification between the intervention and control groups at any of the three-time points (Table 4). The BMI of the majority of students was in the normal range throughout the intervention period.

LTFU was slightly higher in the control (54%) than in the experimental group (50%). There were no differences at baseline between students LTFU and those who completed the study in either group for weight, height, BMI and hip circumference (results not presented). Students LTFU in the intervention group had a significantly higher waist circumference (independent samples t-test p-value=0.04, LTFU 69.5±6.3; completers 67.7±5.7) and triceps skinfold (independent samples t-test p-value=0.027, LTFU 20.4±5.7; completers 18.6±5.5) at baseline than completers.

DISCUSSION

The present study investigated the efficacy of a self-help weight management manual in limiting weight gain in FYFS living in university residences. Both groups had gained weight after the first three months, with no difference between the two groups. However, while weight gain in the control group continued after three months, it reached a plateau in the intervention group, culminating in significant 0.9kg (30%) lesser weight gained at eight months. The weight gain of 2.5 kg in the control group over the eight month period was in line with the self-reported weight gain of 3.1kg reported by Senekal (1994) for South African students and international trends of between 1-4 kg reported for students in cross-sectional surveys (Anderson et al. 2003; Gropper et al. 2012; Fedewa et al. 2014; Kelly & Latner 2015; Vandeboncoeur et al. 2016). The more limited weight gain in the intervention group may be reflected in the significantly lower BMI of this group when compared to the control group at Follow-up 2. Waist circumference remained significantly lower in the intervention group at Follow-up 2 than that of the control group. This is despite the significant increase in waist circumference experienced within the intervention group and not within the control group. Although the majority of FYFS in both the intervention and control groups were normal weight at all three time points, a clear trend for an increase in the proportion overweight FYFS over time is evident, although less pronounced in the intervention group.

One may argue that limiting weight gain by approximately 1 kg is not clinically significant. However, clinical significance in this instance may relate to longer rather than short term effects of small, but significant weight gain prevention outcomes in young adults. Previous research at the same university showed that a third of those who gained weight during their first year continued to gain weight and weighed approximately 7 kg more by the end of their fourth year on campus (Senekal 1994). Lowe et al. (2015) furthermore reported that variability in body weight over an initial time period predicted weight gain over a longer time span in young,

normal weight females who were concerned about their weight. These authors speculate that weight variability may signal the degradation of body weight regulatory systems, resulting in accelerated weight gain, particularly in those with a genetic susceptibility toward becoming overweight. Hivert et al. (2007) who reported a 1.3kg lesser weight gain in their student weight gain prevention intervention group, agree that prevention of small absolute changes in weight and resulting effects on the lipid profile, if maintained over a prolonged period, could result in significant long-term health benefits.

When published interventions for prevention of weight gain by FYFS or college students are considered, it is evident that none focused on making use of a self-help manual, with our 2003 research thus making a novel contribution in this regard. Published interventions include a weight gain prevention program in the form of a one-semester nutrition science course tested in a randomised controlled trail at an American university; neither the intervention nor the control group experienced significant weight gain in. (n=40 FYFS) (Matvienko et al. 2001). Kattelmann, Bredbenner and White (2014) also found that a 10-week intensive intervention that covered 21 web-based mini-educational lessons combined with three e-mails (nudges), followed by 12 months of receiving four nudges per month, resulted in no difference in weight gain in first year USA students. In a 14 week RCT conducted by Dennis et al. (2012) in the USA it was found that both an intervention focused on improving outcome expectations and self-efficacy within a social cognitive theory framework, as well as an alternative intervention that targeted the same variables but focused on explicit training in self-regulation skills, failed to limit weight gain in first year students. Levitsky et al. (2006) reported that two interventions based on a tissue monitoring system algorithm for weight management [Caloric Titration Method (CTM)], facilitated weight gain prevention in the intervention groups, while the control groups gained a significant amount of weight. The CTM estimates changes in body tissue from daily weight measures and subjects are provided with graphic feedback on changes in their tissue weight to provide a basis for changing energy intake or expenditure to maintain weight at a prescribed level (Levitsky et al. 2006). Bertsz et al. (2015) also found the CTM to be effective in preventing weight gain in first-year university students of both genders over a one year period. Hivert et al. (2007) reported successful weight gain prevention in normal weight young Canadian university students by providing the intervention group with educational inputs on maintenance of a healthy lifestyle in the form of small group seminars over a two-year period. Finally, Gow et al. (2010) found that the combination of a 6-week online intervention with weight and energy intake feedback over a six week period resulted in better weight gain prevention in first-year students in the USA than implementation of either of these two interventions independently.

It is evident that a range of intervention approaches, strategies, content, delivery methods, intensities and durations were applied in an attempt to facilitate prevention of weight gain, with more intense interventions not necessarily being more successful. We posit that the large numbers of FYFS entering universities at the beginning of an academic year, the limited opportunities to access these students personally or even in groups, especially during their first few weeks on campus, necessitate intervention approaches, such as self-help options, that can be accessed on an ongoing basis as students find time.

The fact that the residences were not randomly allocated to intervention and control groups is a limitation, so is the fact that only students who resided in residences were included, limiting the generalizability of the results. Furthermore, there was a LTFU of 52% during the study period of eight months and the intervention effect should, therefore, be interpreted with caution.

Bearing in mind the mentioned limitations we conclude that a self-help manual may be a feasible and potentially successful method to limit weight gain in situations where large numbers of students need to be reached in a short time period. We anticipate that combination of our self-help manual with intervention elements such as web-based and social media messaging may increase the intervention effect. However, to ensure sustainability in the longer term any additions to the manual should not involve one-on-one

engagement with students, either in person or online, as this would require the appointment of one or more persons to service this component on an ongoing basis, which may not be sustainable.

REFERENCES

Anderson, D.A., Shapiro, J.R., Lundgren J.D., 2003, The freshman year of college as a critical period for Weight gain: An initial evaluation. Eating Behaviours 4, 363-367.

Baranowski, T., Cullen, K.W., Nicklas, T., Thompson, D. & Baranowski J., 2003, Are current health behavioral change models helpful in guiding prevention of weight gain efforts? Obesity Research 11(Suppl), 23S-43S.

Bertz, F., Pacanowski, C.R., Levitsky, D.A., 2015, Frequent self-weighing with electronic Graphic feedback to prevent age-related weight gain in young adults. Obesity 23, 2009–2014.

Das, B.M. & Evans, E.M., 2014, Understanding Weight management perceptions in first-year college students using the health belief model. Journal of American College Health 62: 488-497.

Dennis, E.A., Potter, K.L., Estabrooks, P.A. & Davy, B.M., 2012, Weight gain prevention for college freshmen: Comparing two social cognitive theory-based Interventions with and without explicit self-regulation training. Journal of Obesity 2012, 1010.

Dyson, R. & Renk, K., 2006, Freshmen adaptation to university life: depressive symptoms, stress, and coping. Journal of Clinical Psychology 62, 1231-1244.

Fedewa, M.V., Bhibha, M., Evans, E.M. & Dishman, R.K., 2014, Change in weight and adiposity in college students. A systematic review and meta-analysis. American Journal of Preventative Medicine 47, 641–652.

Finlayson, G., Cecil, J., Higgs, S., Hill, A. & Hetherington, M., 2012, Susceptibility to weight gain. Eating behaviour traits and physical activity as predictors of weight gain during the first year of university. Appetitie 58, 1091–1098.

Gillen, M.M. & Lefkowitz, E.S., 2011, The 'freshman 15': Trends and predictors in a sample of multiethnic men and women. Eating Behaviours 12, 261–266.

Gow, R.W., Trace, S.E. & Mazzeo, S.E., 2009, Preventing weight gain in first year college students: An online intervention prevention to prevent the "Freshman Fifteen". Eating Behaviours 11, 33-39.

Gropper, S.S., Simmons, K.P., Connell. L.J. & Ulrich, P.V., 2012, Weight and Body Composition Changes during the first three years of college. Journal of Obesity 2012, 1-6.

Hivert, M-F., Langlois, M-F., Be´rard, P., Cuerrier, J-P. & Carpentier, A.C., 2007, Prevention of weight gain in young adults through a seminar-based intervention program. International Journal of Obesity 31, 1262–1269.

Holm-Denoma, J.M., Joiner, T.E., Vohs, K.D. & Heatherton, T.F., 2008, The "freshman fifteen" (the "freshman five" actually): Predictors and possible explanations. Health Psychology 27(1S), S3-9.

Kattelmann, K.K., Bredbenner, C.B. & White, A.A., 2014, The effects of Young Adults Eating and Active for Health (YEAH): a theory-based Web-delivered intervention. Nutrition Education and Behaviour 46, S27-41.

Kelly, M.C. & Latner, L.D., 2015, Evaluating patterns of weight and body composition change among college women. Eating Behaviours 17, 157–162.

Latner J.D., 2001, Self-help in the long-term treatment of obesity. Obesity Reviews 2, 87–97.

Levitsky, D.A., Halbmaier, C.A. & Mrdjenovic, G., 2004, The freshman weight gain: a model for the study of the epidemic of obesity. International Journal of Obesity 28, 1435–1442.

Levitsky, D.A., Garay, J., Nausbaum, M., Neighbors, L. & Dellavalle, D.M., 2006, Monitoring weight daily blocks the freshman weight gain: a model for combating the epidemic of obesity. International Journal of Obesity 30, 1003–1010.

Lowe, M.R., Feig, E.H., Winter, S.R. & Stice, E., 2015, Short-term variability in body weight predicts long-term weight gain. American Journal of Clinical Nutrition 102: 995–999.

Matvienko, O., Lewis, D.S. & Schafer, E., 2001, A College nutrition science course as an intervention to prevent weight gain in female college freshmen. Journal of Nutrition Education 33: 95-101.

McLeroy, K.R., Bibeau, D., Steckler, A. & Glanz K., 1988, An ecological perspective on health promotion programs. Health Education Quarterly 15, 351-377.

National Department of Health (NDoH), Statistics South Africa (Stats SA), South African

Medical Research Council (SAMRC) and ICF., 2016, South African Demographic and Health Survey: Key Indicators (report 03-00-09). Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF. p 45.

Patrick, K., Marshall, S.J., Davila, E.P., Kolodziejczyk, J.K., Fowler, J.H., Calfas, K.J., et al., 2014, Design and implementation of a randomized controlled social and mobile weight loss trial for young adults (project SMART). Contemporary Clinical Trials 37, 10–18.

Poobalan, A.S., Aucott, L.S., Precious, E., Crombie, I.K. & Smith, W.C.S., 2010, Weight loss interventions in young people (18 to 25 years old): A systematic review. Obesity Reviews 11, 580-592.

Senekal, M., Albertse, E.C. & Steyn, N.P., 1988, Weight change in first-year female students in residence at a South African University. Journal of Dietetics and Home Economics 16, 83-87.

Senekal M., 1988, Factors related to weight gain experienced by first year female students at the University of Stellenbosch. M Nutrition thesis, Department of Human Nutrition, University of Stellenbosch, South Africa.

Senekal, M., 1994, Weight fluctuations experienced by female students at university and guidelines for long-term weight management. PhD thesis, Department of Consumer Science, University of Stellenbosch, South Africa.

Swanson, W.M., 2016, An opportunity to combat obesity lies in the at-risk college population. Journal of the American Association of Nursing Practitioners 28, 196–203.

Vadeboncoeur, C., Foster, C. & Townsend, N., 2016, Freshman 15 in England: a longitudinal evaluation of first year university student's weight change. BMC Obesity 3: 45.

Webb, J.B., Butler-Ajibade, P., Robinson, S.A. & Lee, S.J., 2013, Weight-gain misperceptions and the third-person effect in Black and White college-bound females: Potential implications for healthy weight management. Eating Behaviours 14, 245–248.

World Health Organization., 2000, Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. Geneva, World Health Organization (WHO Technical Report Series, No. 894). Viewed on 10 December 2016 at http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/.

Williamson, D.F., Kahn, H.S., Remington, P.L. & Anda, R.F., 1990, The 10-year incidence of overweight and major weight gain in US adults. Archives of Internal Medicine 150, 665-672.