Original Article

Effect of Structured Short Message Service-Based Educational Programme on Physical Activity and Body Weight Status among Nigerian Female Undergraduates

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ABSTRACT

Background and Purpose: Universities and colleges are considered as important sites to implement health educational programme. This study investigated the effect of a structured short message service (SMS)-based educational intervention on physical activity participation and weight loss (measured in terms of weight, body mass index (BMI), waist circumference (WC), hip circumference and waist-hip-ratio among female undergraduates.

Materials and Methods: This experimental study recruited 50 consenting female undergraduates with BMI of 25 kg/m² and above from the Obafemi Awolowo University, Ile-Ife, Nigeria. The participants were randomly allocated into either intervention group or control group. The participants in the intervention group received structured-SMS based educational instructions on physical activity and nutritional advice thrice weekly for 8 weeks. The control group were only monitored for assessment but received no intervention. Physical activity was assessed using Pedometer. Measures of body weight status were assessed following the standard procedure. Outcomes of interventions were assessed at the end of the 4th and 8th weeks. Alpha level was set at $P < 0.05$.

Results: The mean ages of the intervention and control groups were 22.0 ± 1.24 years and 21.9 ± 1.32 years, respectively. There was a significant increase in weight (-0.92 ± 2.15 kg vs. 1.52 ± 2.10 kg $P = 0.001$), BMI (-0.35 ± 0.84 kg/m² vs. 0.58 ± 0.81 kg/m²) and WC (-1.72 ± 4.07 cm vs. 0.84 ± 3.23 cm $P = 0.002$) at week four between the experimental and control group. There was a significant increase in weight (-1.40 ± 2.15 kg vs. 1.92 ± 2.61 kg $P = 0.001$), BMI (-0.52 ± 1.18 kg/m² vs. 0.75 ± 1.01 kg/m² $P = 0.001$) and WC (-1.90 ± 4.94 cm vs. 0.86 ± 3.54 cm $P = 0.003$) at week eight between the experimental and control group.

Conclusion: A structured SMS on physical activity and nutritional advice can help to achieve weight reduction and improve physical activity participation among female university students.

Key words: Body weight, physical activity, short message service, undergraduate

INTRODUCTION

Overweight/obesity is a significant public health problem leading to chronic diseases.[1] The World Health Organisation[2] described overweight and obesity as abnormal or excessive fat accumulation that present a risk to health, as such anyone with a body mass index (BMI) of 25.0–29.9 kg/m² and a BMI ≥30 kg/m²

is classified as overweight and obese, respectively.[2] Overweight and obesity are a global public health issue affecting people of all ages. However, worrisome is the upsurge overweight and obesity among young population.[3] These young adults who are in a period of transition from adolescence to adulthood, especially those between the ages of 18sss and 25 years,[3] undergo significant lifestyle changes. [4] Female young adult experiencing

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these changes tends to adopt unhealthy eating habits and sedentary lifestyle, thus resulting in high rates of overweight and obesity among them.[4]

According to the World Health Organisation[5] survey data on Nigeria in 2010, the prevalence of overweight was 26% and 37% in men and women, while obesity was 3% and 8.1% in men and women, thus indicating a higher preponderance of overweight and obesity among female. There is a gamut of factors responsible for the increasing prevalence of overweight and obesity in young adults. Noteworthy is physical inactivity which is often caused by passive transportation and sedentary behaviour.[5]

Literature is replete with the health benefits of physical activity.[6] However, increasing urbanisation and mechanisation seem to rather promote physical inactivity.[7] Accordingly, empirical evidence and experts' opinions recommend physical activity programmes on weight control, which in turn will help reduce its consequences.[8] As a result, there is a proliferation of several approaches to help improve physical activity participation.[8,9] Specifically, expert consensus is that lifestyle intervention that promote modest level of sustained weight loss are likely to confer substantial benefit, as simple dietary restriction has not been associated with successful weight control.[9] However, the most effective platforms that alter or modify lifestyle and behavioural skills for effective weight loss and weight loss maintenance is still controvertible.[10]

Technology in the form of mobile phone is considered as a veritable platform for lifestyle modification and behavioural changes.[11] For example, the use of short message service (SMS) have been shown to be effective as a smoking cessation intervention among college students[11-13] and for diabetes control among youth with type 1 diabetes.[14-16] Therefore, daily text messages are suggested as helpful for disease self-management.[17] In addition, the use of SMSs have been found to be effective in appointment reminder and reducing nonattendance improving attendance rate.[18-20] However, the effectiveness of SMS on weight control among young adults is still less explored. Therefore, the objective of this study was to investigate the effect of a structured SMS-based physical activity intervention on physical activity participation and weight loss among female undergraduates.

MATERIALS AND METHODS

Female undergraduate students from Obafemi Awolowo University (OAU), Ile-Ife, Nigeria participated in this study. The participants were recruited from the female halls of residence at the University. Female undergraduate students who were overweight or obese based on BMI cut-points of 25 kg/m² and above 30 kg/m², respectively were recruited into the study. Sample size determination for this study was based on the formula by Chan[21] - $n = C \times \dfrac{\pi1(1-\pi1) + \pi2(1-\pi2)}{(\pi1-\pi2)^2}$

where $C = 7.9$ for 80% power; $\pi1$ and $\pi2$ and are

proportion estimates. $(\pi1 = 0.25$ and $\pi2 = 0.65)$ Thus,

$$n = 7.9 \times \dfrac{0.25(1-0.25) + 0.65(1-0.65)}{(0.25-0.65)^2} = 20.49 \approx 21 \text{ per}$$

group. A total of 67 female students were invited into the study to be screened. 53 met the inclusion criteria set for the study. Simple random assignment was used to allocate eligible participants to group. Specifically, consecutive participants were assignment numbers at recruitment. Every odd numbered participant was allocated to the experimental Group and every even numbered individuals were assigned to the control group. However, only data of 50 participants was analysed. The Consort diagram of recruitment, randomisation and progression of participants in the study is presented in Figure 1.

Instrument
1. Stadiometer (Leaidal Medical Limited, RGZ-160–) was used to measure the participant's height
2. Weighing scale (RA9012, England) was used to measure the total body weight of the participants in kilogram (kg)
3. Pedometer (model JS-206B), a simple device designed to detect vertical acceleration and measure ambulatory activity such as walking and running with acceptable accuracy was used to assess physical activity (Tudor-locke, *et al.* 2002)
4. Tape rule: An inextensible rule (Made in China) (0.7 cm wide and 150 cm long) was used to measure the waist circumference (WC) and hip circumference (HC) of the participants.

Procedure
Ethical clearance was obtained from the Health Research and Ethics Committee of the Institute of Public Health,
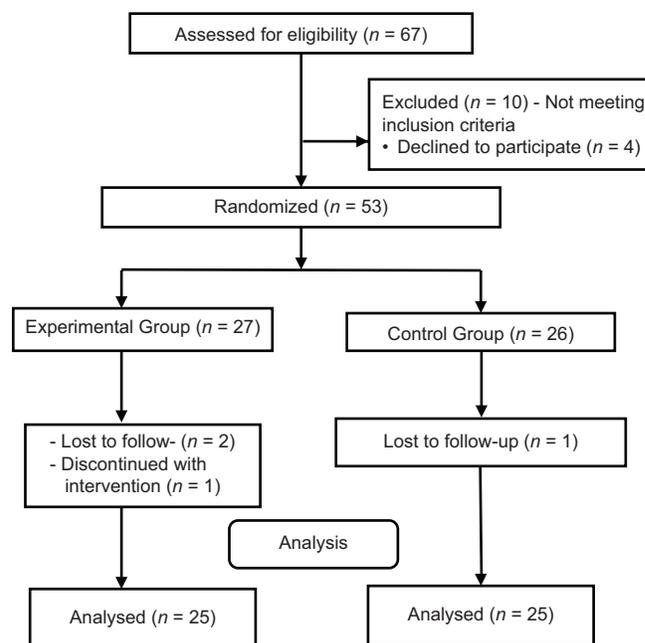
Figure 1: The consort diagram of recruitment and randomization of patients in the study

OAU. Informed consent was obtained from each participant following full disclosure of the purpose and procedures of the study. Each consenting participant was taught how to use and take pedometer reading. Participants were required to wear the pedometer about the waistband about half-way between the side and navel on the waistband of the trousers or skirt. In addition, the participants were instructed to keep the pedometer in the horizontal position and remain parallel to the ground. Data of the pedometer step counts are logged in the device memory storage per week and the details are obtained from the participants through phone calls by the one of the researchers. Thereafter, the participant is instructed to reset the device for use for another week until the end of the study. The average daily pedometer step counts over three consecutive days were used as the reading per week.

Participants in Group A received a structured SMS educational instructions administered thrice weekly for 8 weeks. The SMS educational guide comprised 10 messages on dietary and physical activity instructions. Specifically, the instructions were–

1. Avoid eating when you are nervous or depressed
2. Eat slowly and calmly and chew your food plenty of times
3. Do not work on your computer and eat at the same time. Ensure you concentrate on your food when eating.
4. Ensure to eat responsively (do not rat less or more)
5. Do not miss or skip breakfast, it is your most important meal for weight control
6. Cut down on your calorie by avoiding foods that are high in sugar and fat
7. Instead of taking a bike take a walk to class. Ensure you achieve your minimum of 10,000 therapeutic steps per day
8. Don't get ambitious to ever or always want to achieve your 10,000 steps at once! You may try taking your walk a little bit multiple times throughout the day instead
9. Go for a walk as it will relieve you of stress
10. Stand up, stretch and walk at every hour in hostel, class and everywhere.

Participants in Group B did not receive the SMS instructions. Pedometer was given to the participants in both groups to be used for 3 days and text messages were sent as reminders. Outcomes were assessed at the end of the 4th and 8th week of the study. The anthropometrical assessment (weight, WC and HC) of the participants at baseline, 4th and 8th week of the study was carried out at the Exercise Laboratory of the Department of Medical Rehabilitation, OAU. Tape measure was used to measure the WC of the participants around the body at the level of the umbilical cord with the participants asked to remove clothing materials around the body part. Furthermore, HC was measured at the level of the greater trochanter with the participants in minimal clothing materials around the part. BMI was calculated by dividing weight in kilograms by height in meters squared (kg/m^2). Waist-hip-ratios (WHR) was obtained by dividing WC by HC.

Data analysis

Data obtained was analysed using the descriptive statistics of mean, frequency and percentages. Repeated measures ANOVA were used for within-group comparison of effect of intervention while Independent *t*-test was for between-group comparison. SPSS Statistics for Windows, Version 23.0. (IBM Corp., Armonk, NY) was used or the data analysis. Alpha value was set at 0.05

RESULTS

The general characteristics of the participants are presented in Table I. The mean age for experimental and control groups were 22.0 ± 1.24 years and 21.9 ± 1.32 years, respectively. The participants were comparable ($P < 0.05$) in baseline general characteristics and body adiposity measures, except for HC (101 ± 8.12 vs. 97.9 ± 3.91; t = 2.007: P =0.050) and WHR (0.81 ± 0.06 vs. 0.85 ± 0.06; −2.589: P =0.013). Table II shows there was significant increase from baseline to the eight week in BMI (28.2 ± 1.9 vs. 28.8 ± 2.17 vs. 28.9 ± 2.11; P = 0.001) and WC (84.5 ± 7.48 vs. 85.34 ± 7.35 vs. 85.4 ± 7.74; P = 0.001) among participants in the control group. However, there was significant decrease across baseline, fourth and eighth week, in BMI (27.9 ± 2.75 vs. 27.5 ± 3.24 vs. 27.4 ± 3.22; P = 0.001) and WC (82.9 ± 7.34 vs. 81.2 ± 6.82 vs. 81.0 ± 7.28; P = 0.001). Furthermore, there was significant increase in the pedometer reading across baseline, fourth and 8th week (5991 ± 1801.8 vs. 5972 ± 1726 vs. 6265 ± 2059.8; P = 0.001) among participants in the intervention group [Table III].

Table IV shows that there was significant difference in weight (−0.92 ± 2.15 vs. 1.52 ± 2.10; P = −4.04), BMI (−0.35 ± 0.84 vs. 0.58 ± 0.81 P < 0.05), and WC (−1.72 ± 4.07 vs. 0.84 ± 3.23 P < 0.05). However, there was no significant difference in HC, WHR and pedometer reading (P > 0.05). Table V shows that there was significant decrease in weight in the intervention group (−1.40 ± 2.15) and significant increase in weight in the control group at week eight (1.92 ± 2.61). There was significant differences in BMI (0.52 ± 1.18 vs. 0.75 ± 1.01 P < 0.05) and WC (1.90 ± 4.94 vs. 0.86 ± 3.54) between the intervention and control group. There was no significant difference in WHR and the pedometer readings (P > 0.05)

DISCUSSION

The study investigated the effect of a structured SMS–based intervention on physical activity and body weight status among overweight and obese female undergraduates. The undergraduates were within the age range of 21–25 years. The undergraduates in both groups were comparable in their BMI, HC, WC and WHR, as well as, in their baseline physical activity level. The finding of this study show that undergraduates who received no SMS intervention had no significant improvement in physical activity, while there was a progressive significant increase in body weight, BMI and WC. The significant increase in body weight status can be attributed to the lack of significant

Table I: Comparison of the general characteristics of the participants (*n*=50)

Variable	$\bar{x}\pm$SD		*t*-cal	*P*	All participants
	Experimental (*n*=25)	Control (*n*=25)			$\bar{x}\pm$SD
Age (years)	22.0±1.24	21.9±1.32	0.110	0.913	21.9±1.27
Weight (kg)	72.1±8.18	72.1±6.79	-0.038	0.970	72.1±7.45
Height (m)	1.60±0.04	1.60±0.04	0.860	0.394	1.60±0.04
BMI (kg/m²)	27.9±2.76	28.2±1.96	-0.443	0.660	28.02±2.37
HC (cm)	101±8.12	97.9±3.91	2.007	0.050	99.7±6.57
WC (cm)	82.9±7.34	84.5±7.48	-0.744	0.461	83.72±7.38
WHR	0.81±0.06	0.85±0.06	-2.589	0.013	0.84±0.06

$\bar{x}$: Mean, SD: Standard deviation, BMI: Body mass index, HC: Hip circumference, WC: Waist circumference, WHR: Waist-hip-ratio

Table II: Repeated measure ANOVA comparison of physical activity and body weight status among control participants (*n*=25)

Variable	$\bar{x}\pm$SD			*F*-ratio	*P*
	Baseline	4th week	8th week		
BMI (kg/m²)	28.2±1.96	28.8±2.17	28.9±2.11	4951.0	0.001*
HC (cm)	97.9±3.91	99.1±3.99	99.9±4.69	17890.0	0.001*
WC (cm)	84.5±7.48	85.34±7.35	85.4±7.74	3354.0	0.001*
WHR	0.86±0.06	0.86±0.06	0.85±0.07	5301.0	0.001*
Pedometer reading (steps)	4503.3±1508.0	5106.7±1942.7	5081.3±3170.3	171.7	0.001*

*Significant differences (*P*<0.05). $\bar{x}$: Mean, SD: Standard deviation, BMI: Body mass index, HC: Hip circumference, WC: Waist circumference, WHR: Waist-hip-ratio

Table III: Repeated measures ANOVA comparison of physical activity and body weight status among intervention group participants (*n*=25)

Variable	$\bar{x}\pm$SD			*F*-ratio	*P*
	Baseline	4th week	8th week		
BMI (kg/m²)	27.9±2.75	27.5±3.24	27.4±3.22	2075	0.001*
HC (cm)	101.5±8.13	101.4±8.52	100.5±7.60	4036.0	0.001*
WC (cm)	82.9±7.34	81.2±6.82	81.0±7.28	3609	0.001*
WHR	0.82±0.06	0.80±0.07	0.80±0.07	3903	0.001*
Pedometer reading (steps)	5991±1801.8	5972±1726	6265±2059.8	371.6	0.001*

*Significant differences (*P*<0.05). $\bar{x}$: Mean, SD: Standard deviation, BMI: Body mass index, HC: Hip circumference, WC: Waist circumference, WHR: Waist-hip-ratio

change in physical activity among the students. Physical activity played a significant role in improving weight loss in overweight and obese adults because changes in weight are affected by the amount of energy expended versus the amount of energy consumed.[22] Although the combination of changes in both eating and exercise behaviour is the most effective behaviour for weight loss.[23] Furthermore, the significant increase in the WC from the baseline to the 8 weeks can be associated with change in BMI. This is so because WC is directly proportional to BMI and when weight increase BMI will also increase in line with a study that WC was also found to correlate positively and significantly with BMI.[24]

There were significant reductions in BMI and WC, as well as improvement in physical activity among the participants in the intervention group. The findings of this study are consistent with previous reports by Tarro *et al*[25] that structured-educational intervention delivered through SMS can significantly alter sedentary behaviour and enhance weight loss. Kozak *et al*.[26] and Delisle *et al*.[27] suggest that mobile phone intervention is effective for increasing physical activity and or reducing overweight and obesity. According to Shaw and Bosworth[28], SMS has growing popularity as a way to deliver health information owning to its simplicity, low cost and ability to serve as a cue to action. Evidence shows interventions encompassing both diet and exercise are most successful in preventing weight gain.[29,30] In particular, providing specific information, for instance Sidhu *et al*.[31] explained that some minutes exercising per day or regulating calorie intake can better support maintenance compared to generic material. A review by Hartmann-Boyce *et al*.[32] aimed at identifying effective self-help strategies to support weight loss found that other than self-monitoring and giving advice about diet and physical activity, technological interaction with goal setting plus self-monitoring helped intervention participants lose more weight than controls. [33]

Table IV: Independent *t*-test comparison of the mean change at week four between intervention and control group

Variable	$\bar{x}\pm$SD		*t*-cal	*P*
	Experimental (*n*=25)	Control (*n*=25)		
Δ Weight (kg)	−0.92±2.15	1.52±2.10	−4.05	0.001*
Δ BMI (kg/m²)	−0.35±0.84	0.58±0.81	−3.98	0.001*
Δ HC (cm)	−0.12±2.84	1.14±3.90	−1.31	0.200
Δ WC (cm)	−1.72±4.07	0.84±3.23	−2.46	0.002*
Δ WHR	−0.02±0.04	−0.00±0.20	−1.77	0.008*
Δ Pedometer reading (steps)	−18.7±1462.5	6.02±2072.7	−1.22	0.227

*Significant differences (*P*<0.05). Δ: Change, $\bar{x}$: Mean, SD: Standard deviation, BMI: Body mass index, HC: Hip circumference, WC: Waist circumference, WHR: Waist-hip-ratio

Table V: Independent *t*-test comparison of the mean change at week eight between intervention and control group

Variable	$\bar{x}\pm$SD		*t*-cal	*P*
	Experimental (*n*=25)	Control (*n*=25)		
Δ Weight (kg)	−1.40±2.15	1.92±2.61	−4.20	0.001*
Δ BMI (kg/m²)	−0.52±1.18	0.75±1.01	−4.07	0.001*
Δ HC (cm)	−1.06±1.79	2.00±4.19	−3.36	0.001*
Δ WC (cm)	−1.90±4.94	0.86±3.54	−2.27	0.003*
Δ WHR	−0.01±0.04	0.01±0.02	−0.43	0.670
Δ Pedometer reading (steps)	273.7±1885.1	578.0±3100.7	−0.42	0.680

*Significant differences (*P*<0.05). Δ: Change, $\bar{x}$: Mean, SD: Standard deviation, BMI: Body mass index, HC: Hip circumference, WC: Waist circumference, WHR: Waist-hip-ratio

This study compared the changes observed between the intervention and the control group and observed that there was significant decrease in the weight, BMI and WC, despite that there was no significant difference in the pedometer readings. Structured SMS-based intervention has been shown to be effective in promoting weight loss over 4 months among a group of overweight and obese adult.[34,35] It was observed that there was no significant difference between the physical activity among the intervention and control group. It is assumed that educational interventions focusing on healthful eating and exercise behaviour will help achieve weight loss and prevent weight regain in the long term. According to Strychar[36] who reported that educational interventions on dietary intervention and lifestyle activity results in weight loss that was comparable to aerobic forms of exercise. Nonetheless, certain possible limitations of this study must be acknowledged. This study was for a short period of 2 months. A longer duration is needed to know whether the effects of the intervention can be sustained.

CONCLUSION

A structured SMS text messages on physical activity and nutritional advice can help to achieve weight reduction and improve physical activity participation among university students.

Conflicts of interest

There are no conflicts of interest.

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