

## The effectiveness of an incentivized physical activity programme (Active Student) among female medical students in Pakistan: A Randomized Controlled Trial

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### Abstract

**Objective:** To determine the efficacy of an incentive-based approach combined with a smartphone application in promoting physical activity and weight-loss among female medical students, and to explore among them psychological effects pertaining to self-esteem, guilt, body-shaming, and perception of physical beauty.

**Methods:** The pilot, randomised controlled trial was conducted at the Peoples University of Medical and Health Sciences for Women, Nawabshah, Pakistan, from March to May 2017, and comprised female students who were randomly allocated to either the incentivized or the non-incentivized group. The incentivized group was given a weekly financial incentive based on the required level of physical activity, measured each week for five weeks using Moves application. All subjects completed several questionnaires covering secondary outcomes at the end of the trial. SPSS 20 was used for data analysis.

**Results:** Of the 56 subjects, there were 28(50%) in each of the two groups. The use of financial incentives combined with the smartphone application did not result in a significant increase in physical activity ( $p>0.05$ ). However, within-group weight-loss at the end of intervention was significant for both the groups ( $p<0.05$ ). There was no significant change in the number of steps in the control group during the course of intervention ( $p>0.05$ ), but there was a significant decline in the number of steps in intervention group from weeks 4 and 5 compared to the baseline physical activity ( $p<0.05$ ).

**Conclusion:** Financial incentives combined with a smartphone app designed to track physical activity did not promote physical activity or decrease obesity.

**Keywords:** Financial incentive, Obesity, Physical activity, Smartphone, Student. (JPMA 68: 1438; 2018)

### Introduction

Physical activity (PA) is considered beneficial in reducing the risk of several diseases, and a lack of it in the early years of life may lead to health problems later.<sup>1,2</sup> PA among university students tends to be lower than the general population, with most of them unable to achieve recommended levels.<sup>1</sup> Female students are particularly vulnerable to physical inactivity (PI) and sedentary behaviour.<sup>3,4</sup> Statistics from Western countries show that PI in university students ranges from 23-59%, compared to 44% in the developing countries.<sup>5,6</sup> A recent large-scale study of university students in 23 countries in all of the world's major geographical regions found that average PI ranged 37.1-50.5%. In South Asia, the highest PI prevalence was found in Pakistan (80.6%).<sup>7</sup>

At the same time, it should be noted that obesity

affects all socioeconomic groups irrespective of their age, gender and ethnicity. The younger population is also vulnerable, which makes it an immediate public health concern.<sup>8,9</sup> A further worry is that for all weight groups, weight-based harassment and bullying have been associated with anxiety about weight, sedentary and bulimic behaviours, lower body satisfaction, lower self-esteem, depressive symptoms and suicidal ideation.<sup>10,11</sup>

Mounting evidence highlights the importance of financial incentives in stimulating healthy behaviours such as weight-loss, improved diet, gym attendance, and smoking cessation.<sup>12-20</sup> Although several studies have focussed on different financial incentives to promote healthy behaviours in many countries, the evidence from Asian countries, especially Pakistan, is non-existent.<sup>19,21-23</sup> At the same time, several studies have looked at the use of smartphone applications to promote PA and weight-loss.<sup>24-26</sup> However, the results of several systemic reviews and meta-analyses are mixed, suggesting that the issue should be explored further.<sup>24,25,27</sup> More specifically, several studies have used the Moves application, and it has been validated as an accurate

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measure of PA tracking.<sup>28-30</sup>

Given the lack of data from developing countries, particularly Pakistan, on the topic, the current study was planned to evaluate the efficacy of the Active Student Trial, and to assess its psychological effects on self-esteem, guilt, body shaming, and the perception of physical beauty among medical students. The current study (ActiveStudent trial) combines an incentive-based approach and a smartphone application, and was designed to promote PA and weight-loss among female university students.

### Subjects and Methods

The pilot, randomised controlled trial was conducted at the Peoples University of Medical and Health Sciences for Women (PUMHSW), Nawabshah, Pakistan, from March to May 2017. Due to the absence of a trial registry in Pakistan, approval was obtained from the institutional ethics review committee (Letter No: PUMHS/SBA/VC/511).

The study comprised female undergraduate medical students who were overweight or obese, measured by the Asian body mass index (BMI) cut-off values,<sup>31</sup> aged 18-25 years, and active Android/iPhone/Windows smartphone users. Those with known cases of asthma, diabetes mellitus, cardiovascular disease, cancer, physical disability or mental illness were excluded, and so were pregnant and lactating women or those intending to become pregnant within the following two months. Those who were already part of any other PA study, and those who were unable or unwilling to install the Moves application on their smartphone were also excluded.

The selected subjects were randomly allocated to either the incentivized group or the non-incentivized group through a computer-generated randomised table with an allocation ratio of 1:1.

The incentivized group was given a weekly financial incentive based on the following schedule: a) PKR100 (0.95 American dollar [USD]) for logging 7500-9999 steps for  $\geq 4$  days per week; b) PKR200 (1.9 USD) for logging  $\geq 10000$  steps for  $\geq 4$  days per week; and c) PKR300 (2.85 USD) for logging  $\geq 12000$  steps for  $\geq 4$  days per week. On the other hand, the control group was not given any incentives.

PA, in the form of step count, was measured each week for five weeks by the Moves application (ProtoGeoOy Inc., Helsinki, Finland).<sup>32</sup> The tool has been validated as accurate for this purpose.<sup>28,30</sup> Participants were instructed to download the application and leave it running in the background with their smartphones switched on. They

were told to carry their phones with them at all times, either in a pocket or on a belt clip.

Demographic and general information was obtained through a questionnaire. BMI was measured at the beginning and at the end of the trial. Participants also completed several questionnaires covering secondary outcomes at the end of the trial [see Supplementary material]. Prior to the inclusion in the study, all subjects signed an informed consent form. All the participants were given a detailed description of the study, and their anonymity and data confidentiality was guaranteed.

Data was analyzed using SPSS 20. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean  $\pm$  standard deviation. Differences between the groups were assessed using the independent t-test. The significance level was set at  $p < 0.05$ . Variation in number of steps taken by study participants across six time points and between the groups were estimated using mixed-design analysis of variance (ANOVA) which had repeated measures with a between-subject factor. Mauchly's test was run to ensure that the assumption of sphericity was met prior to running the mixed-design ANOVA. Post-hoc pairwise comparisons were conducted using Tukey's test corrected with Bonferroni method.

### Results

A total of 268 participants were assessed and 56(21%) who met the inclusion criteria were randomly allocated to the two groups of 28(50%) each (Figure-1).

Of the total, 27(48.2%) subjects were pursuing a Doctorate in Physical Therapy, followed by 23(41%) studying for a Bachelor's degree in Medicine and Surgery (MBBS). Overall, 49(87.5%) subjects were using android-based smartphones and 45(80.4%) reported a family history of non-communicable diseases, including diabetes and obesity. Although 31(55.4%) subjects reported being active, 53(94.66%) were uninterested in participating in any future PA programme (Table-1).

Within-group weight-loss at the end of intervention was significant for both groups ( $p < 0.05$ ). Although participants in the intervention group took more steps and weighed less than the controls, the effect was not statistically significant (Table-2). The intervention group started with relatively higher number of steps than the control group which was noted throughout the study, but there was a steep decline in the number of steps for both

**Table-1:** Demographic characteristics.

Variables	Subcategories	Intervention Frequency (%)/ Mean (SD)	Control Frequency (%)/ Mean (SD)	Total Frequency (%)/ Mean (SD)	t-statistic/ $\chi^2$ value	p value
Age	-	20.36 (1.54)	20.89 (1.77)	20.63 (1.67)	t= -1.21	0.23
CGPA	-	3.20 (0.40)	3.17 (0.34)	3.18 (0.36)	t= 0.21	0.84
Semester	2nd	8 (61.5)	5 (38.5)	13 (23.2)	1.30	0.73
	4th	7 (53.8)	6 (46.2)	13 (23.2)		
	6th	10 (43.5)	13 (56.5)	23 (41.1)		
	8th	3 (42.9)	4 (57.1)	7 (12.5)		
Programme	Bachelor of Science in Nursing	0 (0)	1 (100)	1 (1.8)	3.23	0.36
	Doctor of Physical Therapy	14 (51.9)	13 (48.1)	27 (48.2)		
	Bachelor of Medicine and Bachelor of Surgery	10 (43.5)	13 (56.5)	23 (41.1)		
	Doctor of Pharmacy	4 (80)	1 (20)	5 (8.9)		
Smartphone Operating software	Android	23 (46.9)	26 (53.1)	49 (87.5)	3.18	0.20
	Apple	3 (100)	0 (0)	3 (5.4)		
	Windows	2 (50)	2 (50)	4 (7.1)		
Family History	No	5 (45.5)	6 (54.5)	11 (19.6)	0.11	0.74
	Yes	23 (51.1)	22 (48.9)	45 (80.4)		
Perceived physical activity	Low active	2 (40)	3 (60)	5 (8.9)	1.81	0.61
	Somewhat active	8 (40)	12 (60)	20 (35.7)		
	Active	14 (58.3)	10 (41.7)	24 (42.9)		
	Highly active	4 (57.1)	3 (42.9)	7 (12.5)		
Future interest	Yes	3 (100)	0 (0)	3 (5.4)	3.17	0.08
	No	25 (47.2)	28 (52.8)	53 (94.6)		

SD: Standard deviation.

CGPA: Cumulative grade point average.

**Table-2:** Weekly difference in the number of steps taken.

Week	Group	Mean	SD	t-statistic	P-value
Week 0 (Baseline)	Intervention	12865.36	9364.03	-	-
	Control	9029.82	6346.24		
Week 1	Intervention	11567.29	11205.63	-	-
	Control	9279.18	7433.31		
Week 2	Intervention	9862.43	10015.47	-	-
	Control	8886.93	7425.53		
Week 3	Intervention	9550.75	9035.80	-	-
	Control	7214.68	5764.28		
Week 4	Intervention	7256.79	7027.31	-	-
	Control	6773.46	5600.00		
Week 5	Intervention	6697.00	6339.61	-	-
	Control	6130.29	4698.69		
<b>Post-intervention differences between the groups</b>					
Total steps taken during the intervention	Intervention	57799.61	48416.33	-	-
	Control	47314.36	29280.44		
Weight after intervention	Intervention	67.96	7.36	-1.41	0.17
	Control	70.97	8.62		
<b>Changes due to the intervention in both groups</b>					
Intervention	Weight at baseline	68.67	7.46	4.33	< 0.001***
	Weight post-intervention	67.96	7.36		
Control	Weight at baseline	72.13	8.77	3.16	0.004**
	Weight post-intervention	70.97	8.62		

\*Significant at p&lt;0.05. \*\*Significant at p&lt;0.01. \*\*\*Significant at p&lt;0.001.

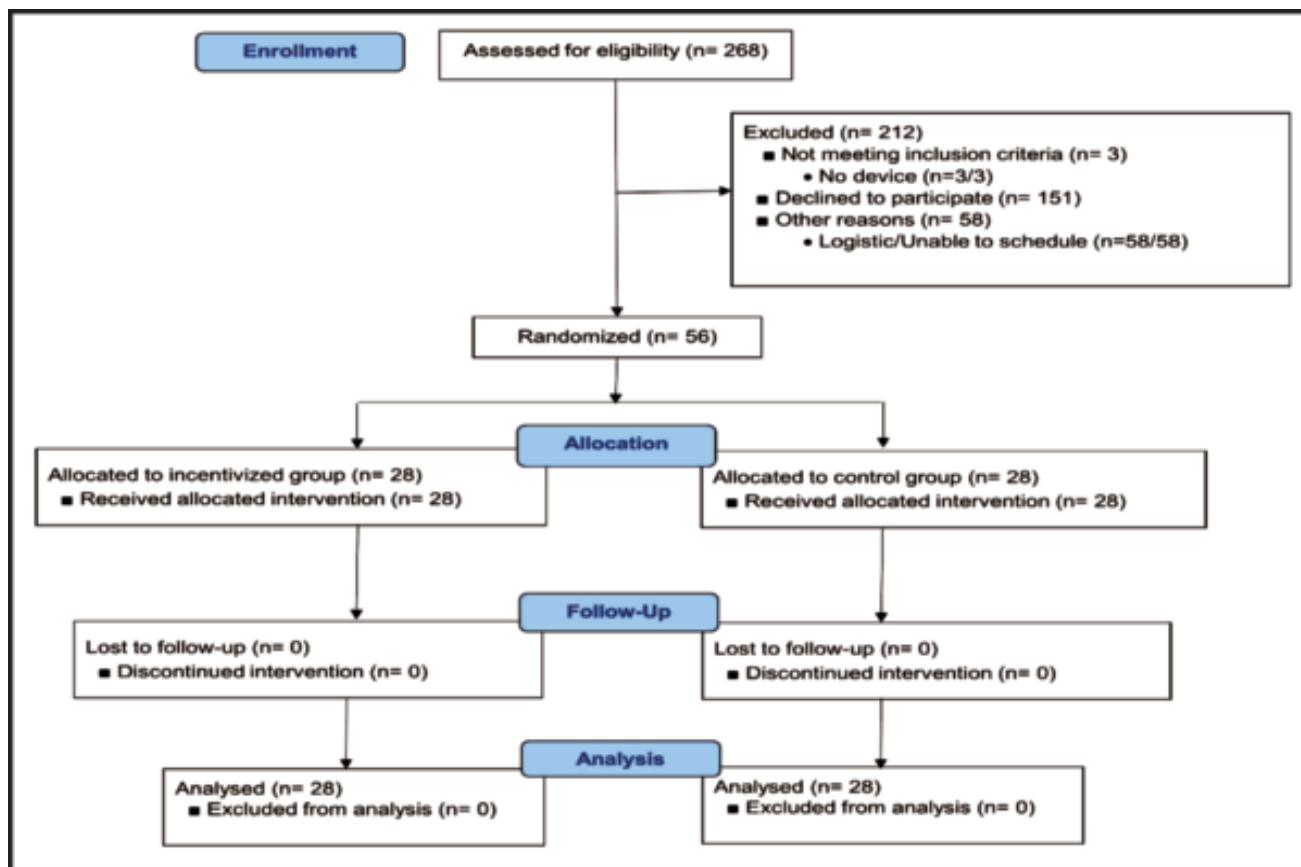


Figure-1: CONSORT flow diagram.

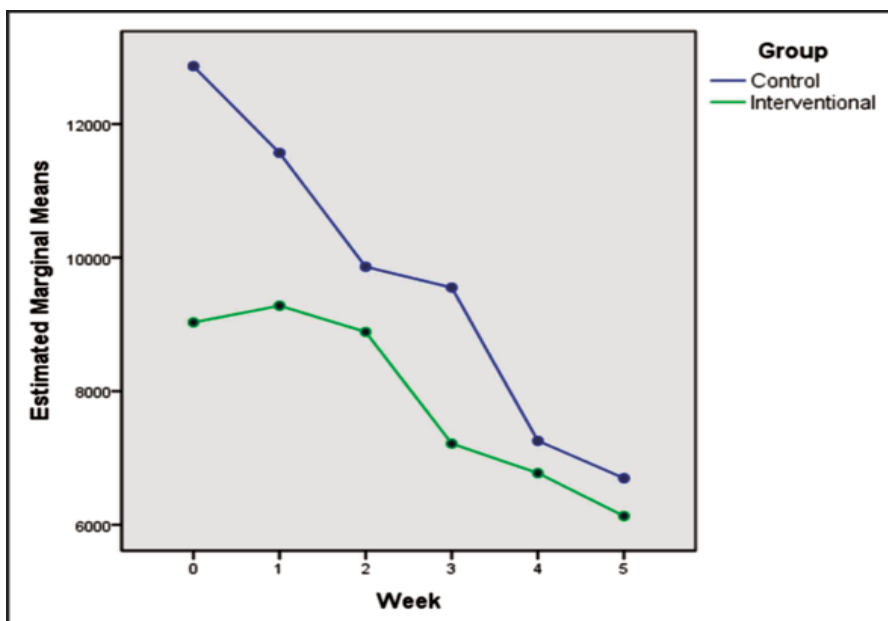


Figure-2: Estimated marginal means of number of foot steps taken across six time points by the intervention and control groups.<sup>a</sup> (Note that W0 represents the baseline week).

the groups (Figure-2).

A significant decline in physical activity was observed across the six time points ( $p < 0.001$ ). There was no significant main effect of the type of intervention and mean number of steps taken during the intervention ( $p = 0.331$ ). There was no significant interaction between time and type of intervention ( $p = 0.284$ ).

There were no significant differences between the number of steps taken from to week 4 ( $p > 0.05$ ). However, compared to the baseline, a significant decline in physical activity was observed at week 4 ( $p < 0.001$ ) and week 5 ( $p < 0.001$ ) in the intervention group.

There were no significant differences

**Table-3:** Post-intervention differences evaluated on secondary outcomes.

Variable	Groups	Mean	SD	t-statistic	P-value
Body appearance scale-2	Incentivized	36.18	8.69	0.26	0.80
	Control	35.57	9.12		
Appearance anxiety inventory	Incentivized	9.07	7.42	-0.27	0.79
	Control	9.57	6.67		
Sociocultural attitudes towards appearance questionnaire	Incentivized	59.75	15.96	0.04	0.97
	Control	59.57	16.84		
Weight control strategies scale	Incentivized	51.21	20.95	0.84	0.40
	Control	46.41	21.31		
Weight and body related shame and guilt scale	Incentivized	15.36	6.84	1.57	0.12
	Control	12.43	7.12		
Physical appearance comparison scale-revised	Incentivized	15.32	7.95	-0.78	0.44
	Control	17.18	9.88		
Physical appearance state and trait anxiety scale - trait	Incentivized	40.57	12.73	0.97	0.34
	Control	36.89	15.60		
Physical appearance state and trait anxiety scale - state	Incentivized	30.68	14.69	0.22	0.86
	Control	29.82	14.96		
Broad conceptualization of beauty scale	Incentivized	36.71	11.41	0.08	0.93
	Control	36.43	14.26		
Weight self-stigma questionnaire	Incentivized	34.64	8.15	1.49	0.14
	Control	31.14	9.42		
Perception of teasing scale-general weight teasing	Incentivized	15.71	5.68	0.65	0.52
	Control	14.64	6.56		
Body image-acceptance and action questionnaire	Incentivized	40.18	13.85	-0.69	0.49
	Control	43.00	16.54		
Locus of causality for exercise scale	Incentivized	9.82	1.68	-1.31	0.20
	Control	10.61	2.69		
Rosenberg self-esteem scale	Incentivized	15.21	2.50	0.34	0.73
	Control	15.00	2.18		
Weight loss readiness quiz	Incentivized	5.54	1.64	0.25	0.80
	Control	5.43	1.55		
Self-efficacy for exercise scale	Incentivized	40.68	16.98	-0.46	0.65
	Control	42.75	16.61		
Feedback on physical appearance scale	Incentivized	24.46	7.78	0.19	0.85
	Control	24.07	7.50		
Physical activity stages of change questionnaire	Incentivized	3.64	1.28	1.36	0.18
	Control	3.14	1.46		
Body dissatisfaction scale	Incentivized	2.21	0.92	-1.07	0.29
	Control	2.57	1.50		

between the groups when measured on several scales and inventories ( $p > 0.05$  each) (Table-3).

## Discussion

This study found that a programme of financial incentives did not result in a significant inter-group difference measured as PA (number of steps), body weight, or secondary outcomes ( $p > 0.05$ ). Although the incentivized group took more steps than the control group throughout the duration of the study, the difference was not statistically significant ( $p > 0.05$ ). However, five weeks after the intervention, within-group weight-loss was significant for both the intervention ( $p < 0.001$ ) and the control group ( $p < 0.05$ ). There were no differences in

number of steps taken by the intervention and control group. However, during the intervention, both groups experienced progressive decline in number of steps taken.

Although smartphone applications are increasingly used in interventions that promote PA and weight-loss,<sup>24-26</sup> several reviews have reported mixed results.<sup>24,25,27</sup> Patel et al. used a combination of the Moves smartphone application and financial incentives in a sample of university employees, and found it effective in promoting PA in obese and overweight individuals.<sup>30</sup> However, the incentives they provided were much higher than those in the current study. Several studies have demonstrated the

short-term (4-12 week) efficacy of financial incentives in stimulating weight-loss.<sup>12,19,33</sup> and, overall, the evidence suggests that monetary incentives do result in goal attainment.<sup>15,34</sup> Although they appear to be effective in sustaining adherence to an exercise programme for more than one year, their potential for promoting exercise maintenance is questionable.<sup>21,35</sup> Additionally, several underlying theories and mechanisms, such as operant conditioning and behavioural economics, have been claimed to be responsible for the effectiveness of financial incentives in influencing behaviour.<sup>36,37</sup>

The use of smartphone applications in health interventions (especially PA research) is widespread, but their psychometric validity remains to be established,<sup>24,29</sup> particularly as a decline in adherence to smartphone-based interventions has been reported.<sup>27,38</sup> Hence, it is essential to include behavioural change techniques in research on PA applications to improve participant motivation.<sup>39</sup>

It has been found that weight status, weather conditions, socioeconomic characteristics and seasonal change influence the efficacy of incentivized PA and weight-loss programmes.<sup>40,41</sup> Although mixed findings have been reported regarding the potential of incentives to improve the uptake of walking programmes and completion rates, some authors argue that factors such as the schedule, size and other contextual factors may alter the efficacy of monetary incentives.<sup>34,40,42,43</sup> It is likely that these factors apply to the population in the current study as the trial was conducted during the summer-time exam season, which may explain the decline in PA during the study. Another potential explanation lies in the Hawthorne effect,<sup>44</sup> as baseline PA was initially considerably higher in both groups at the beginning compared to the end of the study. The step count fell to almost half of baseline for both the intervention (12865.36±9364.03 vs 6697.00±6339.61) and control group (9029.82±6346.24 vs 6130.29±4698.69). It is possible that meagre amount of monetary incentives did not extrinsically motivate the incentivized group in improving the physical activity level (PKR 100 for logging 7500-9999 steps for ≥4 days per week). Future research utilising higher amount of financial incentive as a motivator to improve physical activity is needed.

The findings of the current study reflect that the participants were sedentary on the basis of number of steps taken during the study period. Additionally, 55.4% believed that they were physically active, but 94.66% of them were not interested in participating in any future PA

programme. This shows that the participants were intrinsically not motivated to participate in physical activity. Moreover, an incorrect perception of physical activity may suggest participants' lack of understanding of physical activity. The most likely reasons for this include highly demanding study schedules and commitments and lack of integration of PA and emphasis on its importance in undergraduate curricula.

Furthermore, previous studies have recommended adopting a randomised control design with a larger sample size over a longer duration.<sup>45,46</sup> The current study is a first step in this direction in the context of developing countries where the consequences of obesity and PI can be a costly public health burden. Simple, cost-effective preventive measures may help to address the enormous direct and indirect costs associated with PI and obesity.

To the best of our knowledge, this is the first study in South Asia (particularly Pakistan), on the combined use of financial incentives and smartphone technology to improve PA and reduce body weight in overweight and obese subjects. However, it has a few limitations. As mentioned earlier, due to the absence of a trial registry in Pakistan, approval was obtained from PUMHSW, Nawabshah.

Based on our findings, we recommend that future studies should recruit a larger sample from more diverse settings, divided equally into intervention and control groups, with incentives that are designed to optimally motivate participants. Our study did not include a pre-intervention assessment of secondary outcomes, and future work should include pre- and post-intervention assessments. A further consideration is that this intervention was limited to female participants. We recommend that future studies should also assess efficacy in males. The study used self-reporting measures, which can increase recall bias in the assessment of outcomes. Finally, the combined use of financial incentives and rigorously designed smartphone technology for tracking PA, along with dietary and cognitive behavioural interventions are recommended as a way to improve PA and reduce body weight.

## Conclusion

Although there was a noticeable reduction in body weight in both the groups after the five-week intervention, the combination of financial incentives and smartphone applications were not found to be effective in promoting PA and in decreasing obesity.

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