A Gamified Approach to Reduce Obesity Through Physical Activity

Muhammad Waseem Jamali, Muhammad Saleem Vighio, Muti-ur-Rehman Bhutto, Jairam Das Bather
Quaid-e-Awam University of Engineering, Science & Technology, Nawabshah
*Correspondence: mrehman_bhutto@quest.edu.pk

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Obesity is a major global health problem, directly affecting both illness and death rates. Sedentary lifestyles have led to high obesity rates, especially in developing countries like Pakistan. This study explores how gamified mobile apps can encourage physical activity to help fight obesity. The STRAVA app was used in a gamified intervention to track physical activity, motivation, and weight loss among participants. A quasi-experimental study design was used to assess the effectiveness of gamification in promoting behavioral change. The results show that gamification can significantly boost motivation, participation, and long-term commitment to physical activity, leading to weight loss and better health. The study highlights the potential of gamified mobile apps as affordable and scalable solutions for reducing obesity.

Keywords: Global Health, Quasi-Experimental Study, Gamified Mobile Apps, Affordable Solutions, STRAVA App, Obesity

Introduction:

Obesity has become a global epidemic, leading to serious health issues like cardiovascular diseases, diabetes, and other chronic conditions. According to the World Health Organization (WHO), 650 million adults were obese in 2016, and the number continues to rise [1]. Poor diet, physical inactivity, and a sedentary lifestyle are the main causes of obesity. High consumption of processed foods and calorie-dense diets, along with a lack of physical activity, have contributed significantly to this increase [2].

In Pakistan, obesity rates are rising due to urbanization and changing lifestyles. Around 25% of Pakistani adults are obese or overweight, requiring urgent intervention [3]. Obesity among children and adolescents is also growing, mainly due to reduced physical activity and increased screen time [4]. This trend presents a serious public health challenge, as obesity is a major risk factor for non-communicable diseases like hypertension, type 2 diabetes, and metabolic syndrome [5].

Physical inactivity is one of the leading causes of obesity. In today's sedentary world, longer sitting hours, minimal physical movement, and over-reliance on technology have reduced the focus on physical activities. Studies have shown that sedentary behavior is linked to a higher body fat index and an increased risk of chronic diseases [6]. Traditional methods to encourage physical activity, such as gym memberships or organized exercise programs, often fail due to a lack of motivation and consistency [7]. Gamification has emerged as a promising strategy to address these challenges by making physical activity more engaging. It uses game elements like points, leaderboards, challenges, and rewards to motivate and encourage participation in non-game contexts [8].

Gamified mobile apps have proven effective in encouraging regular physical activity [9].

These mobile apps make exercise more enjoyable and interactive, helping users stay committed to their fitness goals. Features like virtual competition, goal setting, and feedback contribute to long-term adherence to physical exercise. Research has shown that people using gamified apps are more committed and motivated to exercise than those following traditional workout routines [10].

STRAVA is a popular fitness-tracking app that incorporates gamification features like social challenges, leaderboards, and social connections to encourage users. It allows users to track their exercise, set fitness goals, and compare their progress with friends, making physical activity both rewarding and fun [11].

This research explores how the STRAVA app can be used to promote healthier behaviors through gamification. The findings could provide valuable insights for policymakers, healthcare professionals, and tech developers on creating effective health interventions to combat obesity.

Objectives and Novelty of the Study:

This study investigates the effectiveness of using a gamified mobile application, STRAVA, to promote physical activity and combat obesity among overweight individuals. By employing a quasi-experimental design, the research compares the outcomes of participants using the STRAVA app with those following a traditional fitness routine. The core objective is to assess how game-based elements such as leaderboards, challenges, and rewards influence motivation, engagement and sustained behavioral change. The study aims to provide practical insights into how digital interventions can address obesity through enhanced user participation and adherence to physical activity.

What sets this research apart is its focus on a real-world application of gamification in a developing country context, where such interventions are rarely studied. Unlike many prior works that rely solely on self-reported data or controlled lab environments, this study combines real-time activity tracking with psychological motivation assessment using the

Intrinsic Motivation Inventory (IMI). It highlights the potential of gamified health tools to serve as scalable, low-cost solutions for lifestyle-related health issues. By bridging the gap between behavioral science and mobile health technology, this research offers a novel perspective on tackling obesity through engaging, user-driven digital strategies.

Literature Review:

Obesity is one of the world's greatest public health concerns. According to the World Health Organization (WHO), the prevalence of obesity has nearly tripled since 1975, with 39% of adults over the age of 18 being overweight and 13% obese [1]. The rise in obesity is strongly linked to the increasing incidence of non-communicable diseases like diabetes, hypertension, and cardiovascular disease [2]. The primary causes of obesity are the overconsumption of calories, physical inactivity, and a sedentary lifestyle [3].

Over the past two decades, obesity rates have risen sharply among urban populations in Pakistan. Currently, 25% of Pakistani adults are either obese or overweight, largely due to the shift from manual labor to sedentary jobs and decreased physical activity levels [4]. Obesity is also rising among children, as many are adopting sedentary lifestyles, and spending more time on video games and social media instead of engaging in outdoor play [5].

Physical activity is essential in preventing and managing obesity. Regular exercise helps regulate body weight by improving metabolic function and increasing energy expenditure. The WHO recommends at least 150 minutes of moderate-intensity physical activity per week for adults to maintain a healthy weight [6]. However, many people fail to adhere to these guidelines due to motivational barriers, limited access to fitness facilities, and time constraints [7].

Gamification involves using game elements like points, badges, leaderboards, and real-time feedback in non-game contexts to boost motivation and engagement [8]. This concept has gained popularity, especially in health and fitness, where digital platforms use game mechanics to promote behavioral change [9]. Gamified mobile health (mHealth) apps, such as STRAVA, Fitbit, and Nike+ Run Club, encourage users to be more physically active by incorporating competition, achievement tracking, and social connectivity.

Studies have shown that gamification enhances intrinsic motivation and encourages users to stick with fitness routines over the long term [10]. Research into gamification's effectiveness in promoting physical activity has yielded positive results. Rodrigues et al. [11] found that users of gamified fitness apps adhered to physical activity routines 35% more often than those following traditional exercise regimens. Similarly, a meta-analysis by O'Donovan et al. [12] showed significant improvements in physical activity levels, enjoyment, and sustained engagement through gamified interventions.

Furthermore, research on the STRAVA app revealed that users who participated in social challenges and leaderboards were more likely to meet their fitness goals compared to those who only used the app to track their activities [13]. These findings highlight the potential of gamified mobile apps as an effective tool for obesity prevention and management.

Despite the benefits, gamification in health apps faces challenges. Some users may drop out once the novelty of the game-like features fades, while others may be demotivated by competitive aspects like leaderboards and challenges [14].

Additionally, the success of gamified interventions depends on user adherence and ongoing participation [15]. Long-term studies are needed to evaluate whether gamification can maintain behavior change beyond the initial stages of adoption.

Methodology:

The study used a quasi-experimental research design to evaluate the effectiveness of gamified mobile applications in increasing physical activity and reducing obesity. A pre-test and post-test approach was implemented to compare the impact of the gamified mobile intervention (STRAVA application) with a traditional fitness program. Participants were divided into two groups: the experimental group, which used the STRAVA application, and

the control group, which followed a standard physical activity routine. This setup allowed for the assessment of behavior changes over three months.

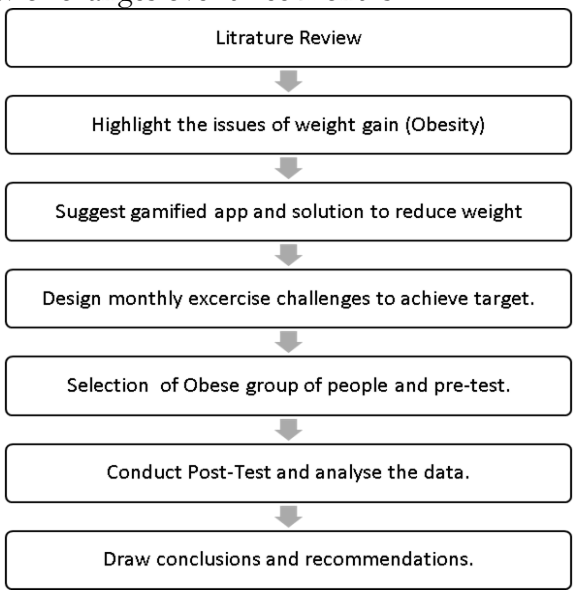

Figure 1. Flow Diagram of Methodology for Gamified STRAVA Intervention.

The study involved 60 participants (30 in each group), all of whom were either obese or overweight (BMI ≥ 25). Participants were voluntarily recruited and were between the ages of 18-45, with no existing health conditions that would interfere with physical activity. Additionally, participants had to own a smartphone capable of running the STRAVA app. Ethical approval and informed consent were obtained from all participants before enrollment.

The intervention lasted for 12 weeks. During this period, participants in the experimental group used the STRAVA app to track their physical activity, with gamification elements such as leaderboards, achievements, and virtual rewards to encourage engagement. The control group followed a self-reported fitness program without any gamified features. Data were collected at three key time points: baseline (week 0), midpoint (week 6), and post-intervention (week 12). The following methods were used for data collection:

- **Pre-Test and Post-Test Assessments:** Participants' weight, BMI, and weekly physical activity levels (measured in minutes) were recorded at the start and end of the intervention.
- **STRAVA Activity Logs:** The app automatically tracked participants' daily physical activity, including distance covered and calories burned.
- **Self-Reported Surveys:** Surveys measured motivation, engagement, and adherence to the fitness regimen. The Intrinsic Motivation Inventory (IMI) was used to assess motivation levels.
- **Handling of Missing Data:** No missing data were observed during the study period. All 60 participants completed the full 12-week intervention, and no cases were excluded from the analysis. This ensured consistency in the dataset and strengthened the reliability of the statistical comparisons between the experimental and control groups.

Statistical analysis was conducted using SPSS software. Paired T-tests were used to compare pre-test and post-test scores, evaluating changes in physical activity levels and weight reduction between the experimental and control groups. Independent samples T-tests were also performed to compare differences between the two groups. The effect size was calculated to determine the magnitude of gamification's impact on behavior change. Additionally, correlation analysis was conducted to assess the relationship between motivation levels and long-term engagement in physical activity.

Results:

This section presents the findings of the study based on the analysis of pre-test and post-test data, aimed at evaluating the impact of gamification on physical activity, weight loss, and motivation levels among overweight individuals. Descriptive and inferential statistics were applied using SPSS software, including paired and independent samples T-tests, along with correlation analysis to examine relationships between intervention components and behavioral outcomes.

Physical Activity and Weight Reduction Outcomes:

Baseline measurements indicated no significant differences in physical activity levels and BMI between the experimental and control groups. However, post-intervention data revealed notable distinctions. Participants in the experimental group, who utilized the STRAVA app, demonstrated a marked increase in physical activity and a greater reduction in body weight.

Table 1. Pre-Test and Post-Test Results

Group	N	Mean Physical Activity (min/week)	Mean Weight Reduction (kg)
Control Group	30	60	2.1
Experimental Group	30	120	4.2

The experimental group achieved a 100% increase in weekly physical activity, along with a substantial weight loss, affirming the efficacy of gamification in promoting healthier behaviors.

Paired T-tests confirmed that the within-group differences in pre- and post-test values for the experimental group were statistically significant ($p < 0.05$). Independent samples T-tests also revealed significant between-group differences in post-test scores, substantiating the hypothesis that gamified interventions enhance engagement and physical activity adherence.

Table 2. Participant Demographics

Demographic Variable	Value
Sample Size	60 participants
Age Range	18–50 years
Gender Ratio	38 M/22 F
Mean Baseline BMI	32.5 ± SD

Visual Comparisons of Activity and Motivation:

Figure 2 illustrates the shift in weekly physical activity levels. The pre-test average was 45 minutes per week, which increased to 120 minutes post-intervention among the experimental group.

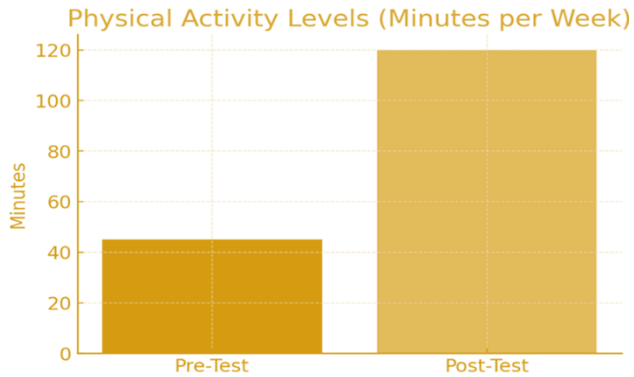

Figure:02 Comparison of Physical Activity Levels (Pre-Test vs. Post-Test)

Figure 3 presents the change in motivation levels using the Intrinsic Motivation Inventory (IMI). Average scores rose from 2.8 to 4.1 on a 5-point Likert scale, indicating a significant improvement in intrinsic motivation following the gamified intervention.

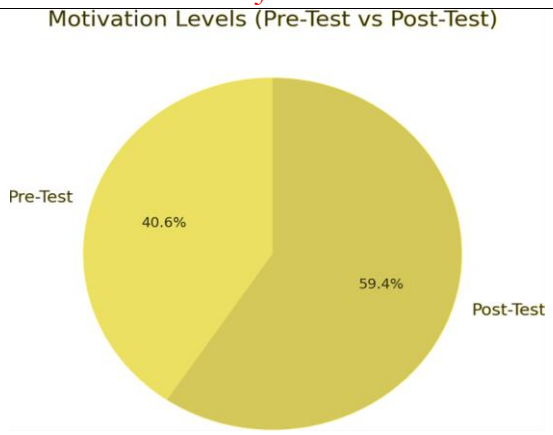

Figure 3. Changes in Motivation Levels (Pre-Test vs. Post-Test)

Statistical Summary of Key Measures:

Results of paired T-test for levels of physical activities before and after intervention. The result from the paired T-test was positive showing a statistically significant rise in time participants spent doing physical activities after using the gamified app STRAVA.

Table 3. Paired T-Test Results for Physical Activity

Measurement	Pre-test mean (minutes/week)	Average of Post-test	T-statistic	p-value:
Physical Activity	45 minutes	120 minutes/week	6.85	< 0.01

The results of the paired T-test for reduction of weight are presented in Table. The data indicates that there is a highly significant reduction in weight in the participants during the intervention period of three months.

Table 4. Paired T-Test Results for Weight

Measurement	**Pre-test mean weight:**	**Post-test mean weight:**	**T-statistic:**	**P-value:**
Weight (kg)	85.6 kg	81.4 kg	5.97	< 0.01

Table 5. Summary of Pre- and Post-Test Differences

Measurement	**Pre-Test Mean**	**Post-Test Mean**	**Mean Difference**	**Clinical Significance**
Physical Activity (min/week)	45 minutes	120 minutes	+75 minutes	Significant increase
Weight (kg)	85.6 kg	81.4 kg	-4.2 kg	Significant reduction
Motivation (Likert scale)	2.8	4.1	+1.3 points	Significant increase

One of the intervention goals is to increase participant motivation to be more active. The average change in scores of motivations showed a remarkable increase from the pre-test to the post-test on a 5-point Likert scale.

The average difference in motivation: was 1.3 points, from 2.8 points in the pretest to 4.1 points in the post-test.

This increase suggests that the gamified app was effective at augmenting participants' intrinsic motivation to be physically active key factor for maintaining behavior change in the long term.

Motivation and Engagement Analysis:

A core objective of the intervention was to enhance participant motivation for sustained physical activity. The increase of 1.3 points in average motivation scores underscores

the effectiveness of the STRAVA app in boosting intrinsic motivation—a critical determinant for long-term behavior change.

Further, qualitative analysis of survey responses indicated that key motivating factors included:

Leaderboards and Challenges: Participants involved in competitive features demonstrated higher consistency in activity.

Goal Setting and Rewards: Virtual achievements positively influenced engagement and adherence.

Social Interaction: Features enabling peer interaction and shared progress were found to increase accountability and enthusiasm.

These findings reinforce the value of gamified elements in mobile health interventions and support the app's role in fostering sustained lifestyle change among users.

Discussion:

The purpose of this study was to evaluate the effectiveness of a gamified mobile application, STRAVA, in promoting physical activity and reducing obesity among overweight individuals. The findings of this study demonstrated that participants who engaged with gamified features exhibited significant improvements in physical activity levels, motivation, and weight reduction, aligning with the hypothesis that gamification contributes to positive behavioral change in health contexts. This section discusses these findings in existing literature.

The increase in weekly physical activity from 45 minutes to 120 minutes and the mean weight loss of 4.2 kg observed in the experimental group supports prior empirical work. In particular, Bojd et al. emphasized that individuals participating in gamified challenges within online weight-loss communities achieved measurable reductions in weight. Their study highlighted that even one challenge per month contributed to an average weight loss of approximately 0.742 kg, confirming the positive correlation between gamification and weight management outcomes [12].

Additionally, the enhanced motivation among users in this study echoes the findings of Shameli et al., who investigated the motivational impact of competitive features within smartphone tracking applications. Their results demonstrated a 23% increase in physical activity when users were involved in competitive challenges, illustrating that competition significantly elevates engagement and adherence levels [13]. This aligns with our study, where leaderboards and challenges in the STRAVA app were found to be major motivating factors in sustaining physical activity behavior over the three-month period.

Moreover, the broader implications of gamification in mobile health (mHealth) are affirmed by the study conducted by Lee et al., who explored the effect of gamification on users' intent to utilize mobile healthcare applications across different demographics. Their structural equation modeling results indicated that gamified elements significantly increased user engagement, particularly among younger and healthier populations. This finding resonates with our demographic, predominantly aged between 18–45, and supports the assertion that gamification is especially effective among technologically literate and health-conscious young adults.

Together, these comparisons reinforce the argument that gamification acts as a powerful tool in health interventions. It not only enhances intrinsic motivation and sustained engagement but also drives measurable improvements in physical and behavioral health metrics. As such, integrating game-design elements in mobile health applications can be considered a viable strategy for public health initiatives aimed at reducing obesity and promoting long-term physical activity, particularly in low- and middle-income countries like Pakistan.

Limitations and Future Work:

This study, while offering promising insights, is subject to certain limitations. The small sample size and short intervention duration limit the generalizability and long-term assessment of gamification's impact on physical activity. Self-reported motivation data may also be prone to bias, despite the use of objective tracking through the STRAVA app.

Additionally, external factors such as social encouragement or seasonal influences were not controlled, which may have affected participant behavior independently of the intervention. Future studies should consider these variables for a more precise evaluation of gamification's effectiveness.

Cross-cultural validation is also recommended to explore how socio-economic and cultural contexts influence the adoption and impact of gamified health interventions. Broader, more diverse studies could offer deeper insight into scalability and adaptability across populations.

Conclusion:

This study explored the impact of gamified mobile applications on physical activity and obesity reduction. The findings show that gamification elements, like leaderboards and rewards, significantly improve motivation and adherence to fitness routines. The experimental group using the STRAVA app experienced greater improvements in activity levels and weight loss compared to the control group, highlighting the effectiveness of gamification.

Gamification effectively combines intrinsic and extrinsic motivation, making exercise more engaging and sustainable. While the study supports its benefits, limitations such as the short intervention duration and reliance on self-reported data suggest the need for further research.

In conclusion, gamified mobile applications offer an effective and scalable solution to promote physical activity and combat obesity. Future research should investigate long-term effects and explore strategies for personalizing the experience to enhance engagement and maximize health outcomes.

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