

A Cluster Randomized Schoolbased Physical Activity Enhancing among Early Adolescents in Bangladesh

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Abstract

Physical activity amongst adolescents drops drastically as they enter secondary school, as cases of overweight and obesity in children increase across the globe. The protocol proposed in this paper describes a proposed intervention and case study assessing an eight-week, fun-themed, schoolbased, physical activity program among 14-year-old children, dubbed "Fit and Fun" under the name: Fit and Fun, children. Methods: It will be a quasi-experimental, two-group as intervention) with versus incomparison study. A single secondary school will be selected in which 30 students at age 14 years will be assigned to an intervention informed consent structured, game-based exercise, three sessionsweek, eight weeks and comparison group (usual physical education. The results will be cardiorespiratory fitness, muscular strength and endurance, flexibility, body mass index, self-reported physical activity, and enjoyment-physical selfefficacy, measured at both baseline and post-intervention using validated field assessments and questionnaires with independent- and paired-sample t-tests or non-parametric equivalents to be used as analysis tools. Since this manuscript is reporting a pre-registered protocol that was provided before data collection, no outcome results are reported. Conclusions: This study will produce initial evidence regarding the viability and possibly fitness, behavioral, and psychosocial gains of a brief, teacher-administered, playful exercise program, which will have consequences in physical education practice and inform the design of subsequent, larger studies.

Keywords: Adolescents, Physical Activity Intervention, Schoolbased Program, Health Related Physical Fitness, Enjoyment and Child Health.

1. Introduction

Early childhood and adolescent physical activity is linked to better cardiorespiratory and musculoskeletal fitness, healthier body composition, and improved psychosocial outcomes, such as increased self-esteem and decreased anxiety and depression symptoms (Bull et al., 2020). Nevertheless, the researcher has this well-documented evidence notwithstanding a substantial proportion of adolescents activity levels in the world are below-recommended, and lack of activity is generally increasing during adolescence (Guthold, et al, 2020). It has been repeatedly found that the period around the early adolescence, generally coinciding with the transition between primary and secondary schooling, is a critical period, where physical activity levels fall the hardest, and a fall generally more so in girls than in boys. Such a change is believed to be a result of both biological, psychosocial and environmental factors, such as less unstructured play, more schoolwork and peer relationships. Simultaneously, childhood and adolescent obesity and overweight have increased significantly in prevalence globally, with an estimate of about 4% of children and adolescents aged 5-19 years being overweight (with obesity being highly predictive of overweight in adulthood) in 1975 and nearly a fifth of children and adolescents being overweight yet obese in recent estimates (NCD, Risk Factor Collaboration, 2017, 2024).

Schools are one of the limited places where almost all children and adolescents can be accessed hence schools are a natural environment to promote physical activities. Nevertheless, school-based physical activity interventions have shown mixed results in literature, and their effects will be more reliant on the way in which the program is designed, the dose of the intervention and whether or not activities are perceived to be fun or simply didactic in nature (Vitali et al., 2019). Structured exercise intervention programs with no focus on fun and motivation can result in less adherence and minimal sustainability of behavior change in the long term, when compared to programs focused on combining physical training with game-like approaches to fun, though (Borrego-Balsalobre, et al, 2022).

2. Physical Activity Decline and Health Consequences in Adolescence

It is recommended by international guidelines that children and adolescents should accrue an average of at least sixty minutes per day of moderate-to-vigorous exercise, and activities that strengthen muscle and bone at least three days per week (Bull et al., 2020). World surveillance statistics show that most teenagers fail to follow these guidelines, and a lack of activity is prevalent across both income brackets, with no significant progress over the years (Guthold, et al, 2018, 2020). This tendency of inadequate activity accompanies and, probably, causes the steep increase in the rates of childhood and adolescent overweight and obesity that has been observed worldwide over the past few decades (NCD, Risk Factor Collaboration, 2017, 2024). Because overweight in childhood is known to follow into adulthood (Singh, Mulder, et al, 2008), and interventions during early-adolescence are deemed as a particularly significant intervention point. Today's scientific world is developed in the best aspect where the present health condition is dull and in the saddest condition because at the age of adolescents are about an incurable point of views. This is why this condition is growing in the worst day after day.

3. School-Based Physical Activity Interventions: Evidence from Randomised and Quasi-Experimental Trials

Structured physical activity interventions have been tested in a number of school-based trials on early adolescents with varying success. A multi-component, cluster-randomized school health promotion program which lasted 28 months in Ecuador generated small but significant effects of intervention on measures of fitness including vertical jump, but less effects on body mass index (Andrade et al., 2014). The same trial was subsequently subgrouped to indicate that the benefits were more apparent in adolescents who were already at increased cardiometabolic risk, which indicated that response to interventions is not necessarily consistent within a study sample. 9 months, twice-week, school-based adapted physical activity intervention of adolescents in Hong Kong achieved effects on various elements of health-related physical fitness, such as cardiorespiratory endurance and muscular strength, relative to a no-treatment control group (Wang et al., 2021, 2022). Although the participants in this trial were adolescents with intellectual disability, not a typically developing population, the clear frequencies, duration, and testing procedure obtained through the trial provide a helpful methodological template to shorter interventions involving a typical developing population, like the one outlined herein. Brazilian Act Teens Program was a cluster-randomised trial implemented over a school term or twenty-four weeks in 13 to 14-year-old schoolchildren, which is a combination of structured physical education, self-monitoring and family-directed lifestyle messaging. The published outcomes demonstrated a positive effect of the intervention on lower-body muscular fitness, but no significant effect on the level of physical activity measured by the device or upper-body and cardiorespiratory fitness, demonstrating that even well-developed, theory-based programs do not ensure a positive effect on all of their outcomes (Stabelini Neto, et al., 2022; Castilho dos Santos et al., 2024). This finding variability highlights the significance of assessing a variety of different fitness and behavioral areas, instead of using just one result, in order to determine a new program like the Fit and Fun for Children.

4. The Role of Enjoyment, Motivation, and Self-efficacy

One theme that may be traced throughout the literature of intervention is that the effectiveness of the programs is highly dependent on the enjoyability and motivation of the participants with regards to the activities. In an investigation of Spanish schoolchildren, increased enjoyment of physical education was linked to more positive self-perception of fitness, and reduced perceived boredom, which confirms enjoyment is not just a by-product but a mechanism that maintains participation (Borrego-Balsalobre, et al., 2022). Likewise, in the naturalistic study of primary-school children in Italy, a long-term, school-based physical activity program was linked to an increase in fitness, pleasure, and physical self-efficacy concomitantly, and muscular strength correlated positively with the levels of activity and pleasure (Vitali et al., 2019). These results correspond with motivation theories, like the self-determination theory.

It suggests that activities autonomy-supportive, competence-building and socially connected motivate more persistent intrinsic motivation than externally promoted and purely instructive exercise (Ryan and Deci, 2000), and with the emphasis of social cognitive theory on self-efficacy as a determinant of health behavior (Bandura, 1986). Though both of these theoretical traditions have been explicitly utilized in programs like the Act Teens Program (Stabelini Neto et al., 2022).

5. Gaps in the Existing Literature and Study Objectives

All taken into consideration, the literature reviewed indicates three recurring themes: first, that the early adolescence period is a critical and time-limited timeframe within which exercise intervention can be issued before activity deterioration ensues; second, that the effects of program on fitness, body composition, and behavioral outcomes are not always uniform and positive; and third, that enjoyment and motivational design seem to be equally important as the dose of exercise in determining whether a program is effective or ineffective. The published trials in this field are mostly large, multi-school cluster trials that have been conducted over many months, or special populations, so there is comparatively little published protocol-level detail available of short, single-school, enjoyment-oriented programs that can be used in typical secondary-school physical education departments. Fit and Fun for Children is aimed at sealing this divide, combining a relatively brief, eight-week, structured exercise program with a specifically playful, game-based presentation, which is both described as an intervention trial and an in-depth case study of a single school-based group of thirty adolescents. The research goals of the proposed study are to: (1) determine the impact of an eight-week structured, game-based physical activity program on health-related physical fitness such as cardiorespiratory endurance, muscular strength and endurance, flexibility) among 14-year-old students; (2) identify changes in self-reported physical activity behavior and body mass index between the intervention and comparison groups; and (3) determine changes in enjoyment of physical activity and physical self-efficacy. The hypothesis is that fitness, activity, and enjoyment-related psychosocial measures change in a more positive way among students in the intervention group compared to the change in the comparison group.

6. Methods

6.1: Design &Participants

The research shall utilize a quasi-experiment, two-group, pre-test/post-test design with a case study approach, which will enable an assessment of the change in time between an intervention and a control group as well as a more detailed, contextualized description of one, limited group of 30, 14-year-old students in one secondary school. The research will be carried out in one of the secondary schools and scheduled physical education time will be used such that delivery will not interfere with curricular time.

The inclusion criteria are:

- (a) age: must be 14 years at the beginning of the study;
- (b) attendance to the participating school;
- (c) medical clearance to engage in moderate-vigorous physical activity, assessed by a standard pre-participation health questionnaire with parent/legal consent; and

(d) written informed consent of a parent or legal guardian, along with student participation consent. Exclusion criteria will be any diagnosed cardiovascular, respiratory or musculoskeletal illness that would render moderate-vigorous exercise unsafe without a tailored medical care, and being unable to undergo baseline fitness evaluation. Thirty qualified students will be recruited.

Since the intervention will be provided during scheduled physical education times, it will be allocated at the level of the existing class sections instead of a one-on-one randomization, to prevent the contamination between the students in the same classes. Two intact classes of eligible 14-year-old students will be selected; one will be randomly assigned such as two-sided coin toss, observed by two members of the research team to the intervention condition and the other to the comparison condition, resulting in the selection of fifteen students in each group with simple random subsampling in case of a section has over fifteen qualified students. Powers Before the intervention, baseline measures will be done in terms of age, sex distribution, body mass index, and baseline fitness scores, which will be statistically checked as baseline equivalency across groups. The proposed sample of thirty is based on the size of a single-school pilot/feasibility study and not an efficacy trial, which is fully powered, and will provide estimates of feasibility, acceptability, and preliminary effect size to guide a follow-up, powerfully effective efficacy trial.

6.2: Ethical Approval

This research will first be presented to the Institutional Review Board / Research Ethics Committee of the institution where the author works before the process of recruitment can commence and will not be carried out in the absence of the approval. Informed written consent will be collected of both parents or legal guardians of all participants, and the informed written consent of the student, following a plain-language explanation of the purpose of the study, procedures, possible risks such as mild muscle soreness or fatigue that comes with moderate exercise, and the voluntary, withdrawable nature of participation at any time without penalty. The fitness testing will be under the supervision of the trained personnel who will be knowledgeable in the basic first aid practices and any student who complains of feeling pain, dizzy or uncomfortable will be allowed to cease. Information will be de-identified with participant codes, housed on a password-secure system that is available to research team only and reported in aggregate form. The comparison-group students will get access to a reduced form of the program once data collection has ceased, so as to reduce withheld benefit.

6.3: Instrumentation

The results will be measured at two stages: baseline as week-0 and after intervention and week-8, one week after the last training session with the help of trained research assistants following standardized procedures. The cardiorespiratory fitness will be measured with the help of a validated multi-stage 20-metre shuttle run, also known as beep test also referred to as PACER-type protocol, where the number of completed stages/laps will be recorded, which has been employed in similar trials in adolescents (Castilho dos Santos et al. 2024). The muscular strength and endurance will be measured through the handgrip dynamometry method.

A timed sits-up or push-up test, and the lower-body power through the standing long jump, as in traditional tests of comparative school-based studies (Wang et al., 2022; Castilho dos Santos et al., 2024). Flexibility will be measured with regard to a standard sit-and-reach test. Height and weight like body mass index will be determined in light clothes but without shoes by using a calibrated stadiometer and a digital scale. The physical activity will be measured as self-reported measurements of an age-specific physical activity questionnaire (adapted to adolescents) specific to the question of how often and how intense physical activity was during the last seven days. The physical activity enjoyment and physical self-efficacy will be assessed with short Likert-scale items adapted to enjoyment and self-efficacy scales in the existing school-based physical activity literature (Vitali et al., 2019; Borrego-Balsalobre et al., 2022). The attendance and any negative occurrence of the session will be recorded in a prospective manner as process/feasibility measures over the eight weeks.

7. Procedures

Eight-week physical activity program focused on a game-based intervention, Fit and fun for children, will be administered to the intervention group instead of regular physical education over three sessions of around fifty minutes such as three sessions each week, which is comparable to the range of reported similar published programs (Stabelini Neto et al., 2022; Wang et al., 2021). The sessions will be four-parts.

They are:

- (a) a five- to eight-minute dynamic warm-up exercise of movement-based games;
- (b) fifteen to twenty minutes aerobic block of exercises through modified team games and relays;
- (c) a fifteen minutes muscular strength and endurance block with body-weight circuit stations structured as timed, game-like station challenges and
- (d) a five to eight minutes cool-down and flexibility block through guided static stretching.

The intensity of the session will increase over the eight weeks, with the skill-familiarization in the initial two weeks, and more intense session in week six to eight. The sessions will be implemented by the physical education teacher along with one of the members of the research team, guided by a written session manual to enhance treatment fidelity and attendance at each session documented. The teachers will present activities in the form of a game and will not provide more options, which are similar tasks, will not give negative feedback, but instead will provide encouragement and competence-based feedback, which has proven to help maintain engagement among adolescents (Ryan and Deci, 2000; Vitali et al., 2019; Borrego-Balsalobre et al., 2022). Those in the comparison group will proceed with the normal physical education program in the school over the eight weeks' time frame, and the same baseline and post intervention test will be administered as in the intervention group. The data collection will occur in four stages: a preparation stage (around two weeks prior to the intervention) to share information, consent/assent, and test eligibility; a baseline examination period such as week-0 during which all participants will take part. It seems to be anthropometric assessment, fitness assessment, and questionnaires like an intervention period as weeks 1-8 where the intervention group follows the twenty-four sessions with the comparison group receiving standard physical education with the attendance and adverse events documented throughout; and a post-intervention measurement period at week 8-9 where all the baseline assessments are repeated using the same procedures and the same personnel and equipment where possible.

8. Data Analysis

Data will be verified to be complete and placed in a password-secured spreadsheet, with 10% of the entries cross-tabulated to confirm their accuracy. Characteristic of the baseline will be summarized using descriptive statistics and baseline equivalence between groups will be checked. The Shapiro-Wilk test and visual inspection will be used to test normalcy of continuous outcomes. The independent-samples t-tests of change scores between-groups or a mixed between-within analysis of variance (group x time) will be used to evaluate between-group differences in change between baseline and post-intervention, with effect sizes reported like Cohen-d or partial eta squared; within-group change will be further evaluated using paired-samples t-tests. In the case of non-normally distributed variables, he will use the Mann–Whitney U test and the Wilcoxon signed-rank test. Since the sample is relatively small, the findings will be viewed more in terms of effect sizes and confidence intervals than significance per se and be considered preliminary or exploratory. The statistical significance will be established at $p < .05$ as two-tailed; statistical analysis will be provided with the help of standard statistical programs e.g., SPSS or R. This predetermined scheme is reported in this case, prior to data collection, to minimize the possibility of post-hoc, outcome-based analytical decisions.

9. Results

Since this manuscript is a report of a study protocol that was submitted before the actual recruitment and data collection, the outcome results are not available yet. Findings ,including descriptive statistics, between- and within-group differences, effect sizes, and confidence intervals of all results outlined in the data analysis section above mentioned will be presented in a future manuscript at the end of the eight-week intervention and assessment period, in line with the analysis plan specified above.

10. Discussion

Considering the trend in the results described in similar school-based programs (Andrade et al., 2014; Wang et al., 2021, 2022; Stabelini Neto et al., 2022; Castilho dos Santos et al., 2024), it is expected that at least some of the aspects of health-related physical fitness, most likely muscular strength/endurance and lower-body strength, will be significantly improved in the intervention group during the eight-week period, although changes in the other two as cardiorespiratory fitness and body mass index are more variable or less significant, given the comparatively short duration of the intervention. It is also expected that, in line with the literature reviewed above on enjoyment and motivation (Vitali et al., 2019; Borrego-Balsalobre et al., 2022; Ryan and Deci, 2000), the game-based, autonomy-supportive administration of the game-based intervention, i.e. Fit and Fun for children, will be linked to positive change in self-reported enjoyment and physical self-efficacy, and good attendance rates, as compared to traditional physical education. In the event of these expected patterns, the study would present preliminary, school based, evidence that a low cost, short, teacher-delivered, program based on structured exercise and playful delivery of the intervention are viable and possibly implemented within the physical education time at school without special equipment and outside instruction. Physical education curriculum planning might benefit of such evidence and the pilot data to design a properly powered multi-school randomized controlled trial would come in handy.

The proposed study has a number of strengths: it employs a comparison group in lieu of a single-group pre-post study design, providing some control over maturation and secular trend; it pre-specifies outcome measures and analysis, eliminating the possibility of selective reporting of outcomes; it bases its intervention design on strategies that have been shown to be relevant in similar published studies; and its case-study element provides rich and contextualized description that would not otherwise be possible with purely quantitative multi-site trials. It has limitations such as the small, single-school sample of thirty as limited statistical power and generalisability, assigning by intact class section instead of randomization which could introduce potential confounding anyway despite the planned baseline equivalence check, a relatively short intervention duration of eight weeks which may not detect change in some outcomes, including cardiorespiratory fitness and body mass index, the use of a self-report method to assess physical activity and enjoyment to possibly introducing potential recall and social-desirability bias, and the lack of an extended follow-up (the sustainability of any observed change after the immediate post-intervention period cannot be founded on this plan. This is recognized here, at the protocol level, to ensure that these limitations are appropriately weighed in when the ensuing results paper is read.

11. Conclusion

The paper has introduced the entire protocol of a proposed eight-week, school-based, and fun based, physical activity intervention, Fit and Fun for Children, among 14-year-old students and provided a detailed case-study description of one of the school-based groups, comprising thirty participants. Informed by the current evidence on the decline of physical activity in adolescence, the efficacy of school-based interventions, and the motivational power of enjoyment and self-efficacy, the study will produce early evidence on the viability and possible fitness, behavioural, and psychosocial benefits of a brief, teacher-administered, play-based exercise programme. By publishing this protocol prior to data collection, it is hoped that the protocol will be used to facilitate methodological transparency, as well as to give a reference point that can be cited in the eventual results paper, after the assessment and analysis have been performed as per the plan outlined above.

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