Saúde e Pesquisa, Maringá (PR)
DOI: 10.17765/2176-9206.2020v13n3p665-673

SMARTPHONES APPLICATIONS TO STIMULATE PHYSICAL ACTIVITY IN BRAZILIAN CHILDREN AND ADOLESCENTS

Thiago Silva Piola

PhD in Physical Education. Research Center on Physical Activity and Health, Universidade Federal do Paraná, Curitiba, PR, Brazil.

Ana Beatriz Pacífico

PhD student in Physical Education. Research Center on Physical Activity and Health, Universidade Federal do Paraná, Curitiba, PR, Brazil.

Eliane Denise Araujo Bacil

PhD in Physical Education. Research Center on Physical Activity and Health, Universidade Federal do Paraná, Curitiba, PR, Brazil.

Michael Pereira da Silva

PhD in Physical Education. Research Center on Physical Activity and Health. Professor at Universidade Federal do Rio Grande, Rio Grande, Rio Grande do Sul, Brazil.

Wagner de Campos

PhD in Motor Development and Sports Studies. Lab Head of Research Center on Physical Activity and Health. Professor at Universidade Federal do Paraná, Curitiba, PR, Brazil.

Corresponding author:
Thiago Silva Piola
tspthiago@hotmail.com

Received in: 29/11/2019
Accepted on: 18/06/2020

ABSTRACT: Evaluate the quality of apps to stimulate the practice of physical activity of Brazilian children and adolescents. We conducted a systematic search for applications in Portuguese on iTunes, and PlayStore platforms were conducted employing the following terms: level of physical activity, physical activity, physical fitness, exercise, physical exercise, motor activity, sport, walks, sedentary and inactive behavior. The quality of applications was evaluated by the Mobile App Rating Scale (MARS). The presence or absence of techniques for behavior change was evaluated by the taxonomy of behavior change techniques. Kendall's Tau correlation coefficient verified the relationship between the quality of the applications and the techniques of behavior changes. Four applications met all criteria and were included in the analysis, with reasonable quality. Regarding to techniques of behavior switching, only users' feedback was common to all applications. Applications were not based on recommendations for promoting physical activity.

KEY WORDS: Adolescent; Child; Mobile applications; Motor activity; Smartphone.

APLICATIVOS PARA ESTIMULAR A PRÁTICA DE ATIVIDADES FÍSICA EM CRIANÇAS E ADOLESCENTES BRASILEIROS

RESUMO: Este estudo objetivou avaliar a qualidade de aplicativos para estimular a prática de atividade física de crianças e adolescentes brasileiros. Foi conduzida uma busca sistemática de aplicativos em português nas plataformas *iTunes* e *PlayStore*, utilizando os seguintes termos: nível de atividades física, atividade física, aptidão física, exercício, exercício físico, atividade motora, esporte, caminhada, comportamento sedentário e inativo. A qualidade dos aplicativos foi avaliada através da *Mobile App Rating Scale* (MARS). A presença ou ausência de técnicas de mudança de comportamentos foi avaliada usando a taxonomia de técnicas de mudanças de comportamentos. A relação entre a qualidade dos aplicativos a as técnicas de mudanças de comportamento foram verificadas pelo coeficiente de correlação de Kendall's Tau. Quatro aplicativos atenderam a todos os critérios e foram incluídos na análise, apresentando qualidade aceitável. Sobre as técnicas de mudança de comportamentos, apenas o feedback dos usuários é comum a todos os aplicativos. Aplicativos não são baseados em recomendações para promoção da atividade física.

PALAVRAS-CHAVE: Adolescente; Aplicativos móveis; Atividade motora; Criança; Smartphone.

INTRODUCTION

Physical activity is any movement that results in energy expenditure higher than rest levels. It is related to improvements in cardiovascular abilities, metabolic health, decrease in anxiety and depression symptoms [1, 2], improvement in quality of life, well-being, good disposition, cognitive functions, and decrease in cognitive and dementia risks [3].

The World Health Organization[2], the American College of Sports Medicine [1] and the U.S. Department of Health and Human Services [4] recommend minimum daily 60-min physical exercises, between moderate and vigorous, to maintain good health conditions in children and adolescents. However, even though there is a widespread knowledge of these benefits in the literature and social media [1-3], most children and adolescents do not reach the recommendations [5].

It is estimated that 80.3% of adolescents are insufficiently active worldwide [6], a percentage that reaches more than 50% in Brazil[7]. In the metropolitan region of Curitiba, Brazil, the percentage of adolescents who do not comply with these minimum recommendations reaches 80%, following the world average [8-10].

The amenities of modern life, such as the use of TV remote controls, the use of escalators and lifts instead of stairs, the use of cars or buses for short distances and the use of smartphones with WhatsApp, Facebook, messenger, even to talk to people in the neighborhood or in the same house favor less energy expenditure and, consequently, contribute towards hypokinesis. Besides being a way of communication that increases the friend's network, smartphones are an attractive source of sedentary recreation and entertainment for young people through different games and have become indispensable even for children and adolescents that tend to use it for several hours per day [11].

On the other hand, although smartphones, as communication media or entertainment, contribute to the decrease of physical activities, they may favor the promotion and maintenance of physical activities through guidelines, incentives and other information on physical activities [12]. However, few studies aimed to evaluate the contents and quality of smartphone applications limiting their searches for applications on the iTunes platform or taking into consideration only applications in English [12-16]. Studies that analyze the contents and quality of applications for the promotion of daily physical activities for children and adolescents do not exist in the literature.

Due to the increasing use of smartphones by adolescents, the visible decrease in the practice of physical activities, and the significant number of applications that stimulate and recommend the practice of physical activities, the current study evaluates the content and quality of applications to stimulate the practice of physical activities in Brazilian children and adolescents.

METHODOLOGY

SEARCH STRATEGY

A systematic search with descriptors in Portuguese, in pairs, was undertaken in September 2019, consulted in Portuguese in Health Sciences Descriptors (DeCS), and English in Medical Subject Headings (MeSH). The search was undertaken on *iTunes* and *PlayStore* platforms by the following terms, divided into two parameters: (i) physical activity level, physical activity, physical fitness, exercise, physical exercise, motor activity, sports, walking; and (ii) sedentary behavior, inactivity. Each term was searched alone and then combined with other terms, using OR and AND to relate terms and to combine the two parameters, respectively.

INCLUSION CRITERIA

We included only applications (i) for children and adolescents; (ii) focused in at least one of the terms used in search; and (iii) applications in Portuguese.

QUALITY OF SMARTPHONE APPLICATIONS

The Mobile App Rating Scale (MARS) evaluated the quality of applications. It is a reliable and multidimensional measurement for testing, classifying, and assessing the quality of health applications [17]. MARS is composed of 19 items grouped into four different domains, namely (1)

commitment (entertainment, interest, personalization, interactivity and target group); 2) functionality (performance, easy to use, navigation, gesture drawing); 3) esthetics (layout, graphs, visual and resources); 4) quality of information (precision of the description of the application, aims, quality and amount of data, credibility, evidence base). All items are measured in a 5-point scale (1 = inadequate; 2 = weak; 3 = acceptable, 4 = good; 5 = excellent). Scores for each domain are calculated as an average of the items in the domain; a general score is the media among domains.

TECHNIQUE OF BEHAVIOR CHANGES

The presence or absence of techniques in behavior changes was evaluated using the taxonomy of techniques in behavior changes, according to Abraham & Michie [18]. The tool employs a dichotomist score 0 or 1, representing absence or presence of technique, respectively.

DATA ANALYSIS

We used mean and standard deviation to describe the applications, and simple and absolute frequencies to descriptive results regarding the technique in behavior changes. One-way ANOVA and by multiple comparisons with Bonferroni's correction test compared the quality of the smartphone applications. The Kendall's tau correlation coefficient verified the relationships between the applications' quality and behavior change. All procedures were performed by SPSS 24.0, with a 95% significance level.

RESULTS

SELECTION OF APPLICATIONS

Figure 1 shows the applications' selection process. *Apple iTunes* and *Google Play Store* revealed 1900 applications. After verifying inclusion criteria, we selected nine applications to download and evaluate their eligibility. Four applications complied with criteria and were included in the analysis.

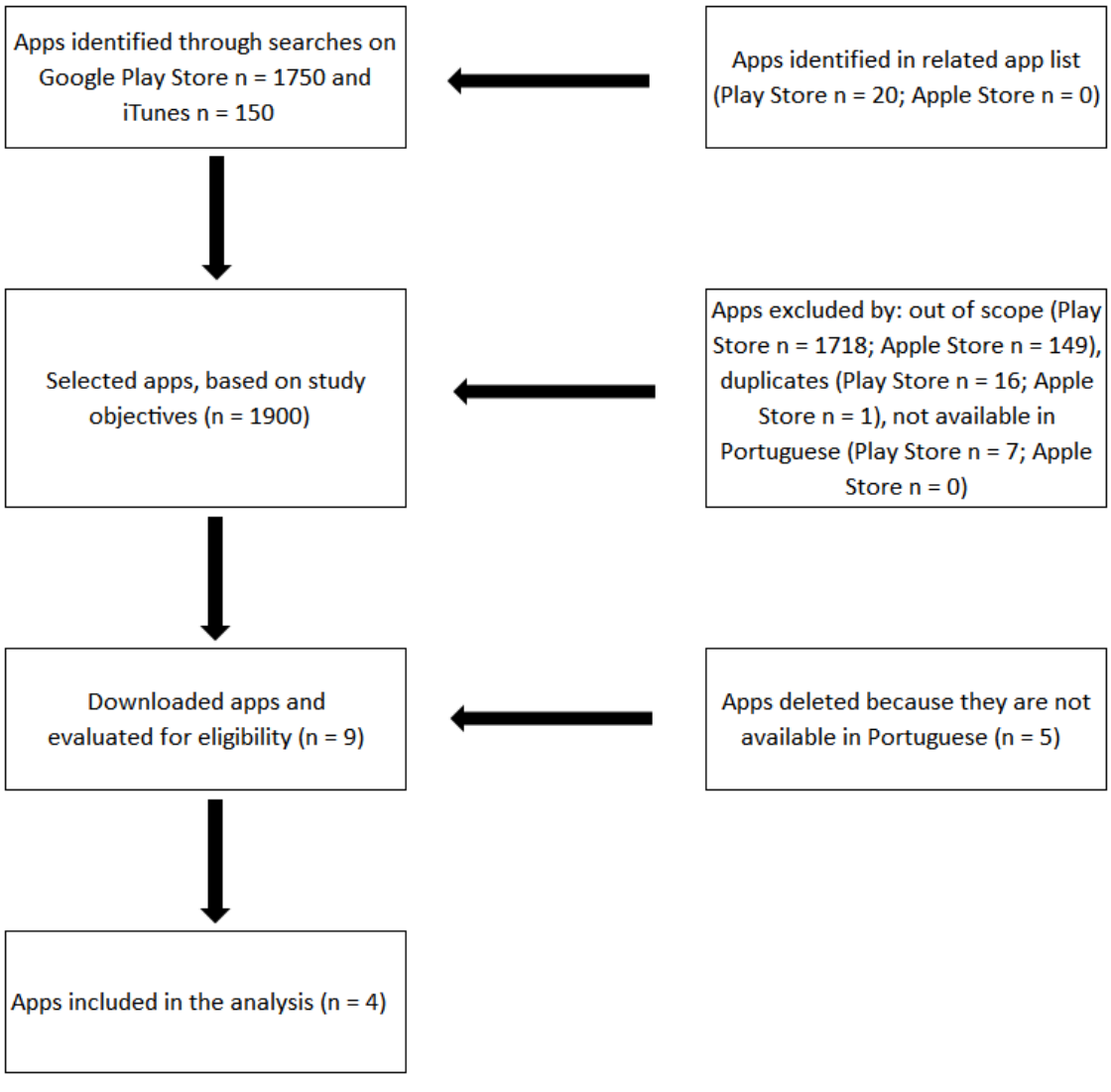

Figure 1. Chart organization of smartphone application selection.

CHARACTERISTICS OF APPLICATIONS

Table 1 shows the characteristics of the applications included in the study. Three applications were obtained from *Google Play Store*, one from *Apple iTunes* and one from both. All the applications had a free download, but one had a paid upgrade. The selected applications presented users' mean evaluation scores 4.17 ± 0.55 (within a 0 – 5 points scale, respectively, the worst and the best evaluation. Two applications were games; one had videos with exercises within a time to be reproduced by the user; one showed pictures of movements to be reproduced. No application required passwords, and applications did not have an accelerometer use, although two used GPS. No application had any educational information on physical activity, and they were not based on recommendations available in the literature. Half of the applications employed games with rewards according to attained aims or scores.

When the quality of applications is compared, we found significant differences between applications "movements of gymnastics" and "Skorkit Kids" (1.20 ± 0.44 vs. 3.40 ± 1.14; p=0.02) for engagement. In the general score, significant differences were reported (p=0.01) between "movements of gymnastics" (1.65 ± 1.72) and "Looking for Bobby" (2.83 ± 1.58), between "movements of gymnastics" and "Sworkit Kids" (3.09 ± 1.78), and between "AXxion: Lost Treasure Chest" and "movements of gymnastics" (2.83 ± 1.58 vs. 1.65 ± 1.72; p=0.01) (Table 1).

Table 1. Descriptive presentation of smartphone applications

	Smartphone applications			
	AXxion: Lost Treasure Chest	**Movements of gymnastics**	**Looking for Bobby**	**Sworkit Kids**
Store	PlayStore	PlayStore	PlayStore	PlayStore and iTunes
Cost	Free and paid	Free	Free	Free
User rating	4.2	3.4	4.4	4.7
***n* appraisers**	5	228	5	11321
Type of app	Game	Images	Game	Exercises
Password	No	No	No	No
Accelerometer	No	No	No	No
GPS	Yes	No	Yes	No
Educational inf.	No	No	No	No
Recommendations	No	No	No	No
Social networks	No	No	No	Yes
Rewards	Yes	No	Yes	No
Gamificação	Yes	No	Yes	No
MARS				
Engagement	2.80 ± 1.09	1.20 ± 0.44	2.80 ± 1.09	3.40 ± 1.14[2]
Functionality	4.50 ± 0.57	5.00 ± 0.00	4.50 ± 0.57	4.75 ± 0.50
Aesthetic	2.33 ± 0.57	1.33 ± 0.57	2.33 ± 0.57	3.67 ± 0.57
Information	2.86 ± 2.19	0.57 ± 1.13	2.86 ± 2.19	1.57 ± 2.37
Total score	2.83 ± 1.58	1.65 ± 1.72[1]	2.83 ± 1.58[2]	3.09 ± 1.78[2]

App: app; MARS: mobile app rating scale; GPS: global positioningsystem; [1]: significantly different from app 1; [2:] Significantly different from app 2; $p < 0.05$. Comparison performed by the ANOVA one-way and Bonferroni post hoc test.

BEHAVIOR CHANGE TECHNIQUES

Table 2 describes the presence of different types of techniques of behavior in applications. Techniques of behavior changes not included in all applications comprise (a) information on consequences and benefits of behavior changes; b) identification of barriers for behavior changes and plans for overcoming them; c) reviewing planned aims; d) behavioral agreement for the changes of habits; e) preparatory activities, rehearsal or repetition of movements to facilitate learning; f) social comparison to facilitate observation of other users; g) planning of support or social change, encouraging other people to help or provide social support (instrumental); h) suggesting being a model for other people; i) suggesting the use of self-learning, self-encouragement for activities; j) stress administration for a decrease of anxiety; k) enhancing self-motivation.

Table 2. Presence of behavior change techniques in the smartphone applications

	Smartphone applications			
	AXxion: Lost Treasure Chest	**Movements of gymnastics**	**Looking for Bobby**	**Sworkit Kids**
Relates behavior and health	Yes	No	Yes	No
Informations on consequences	No	No	No	No
User feedback	Yes	Yes	Yes	Yes
Encourages proactivity	Yes	No	Yes	Yes
Identifies barriers	No	No	No	No
Provides encouragement	Yes	No	Yes	Yes
Defines gradual tasks	Yes	No	Yes	Yes
Provides instructions	Yes	No	Yes	Yes
Demonstrates behavior	No	No	No	Yes
Planning actions	No	No	No	Yes
Review goals	No	No	No	No
Self monitoring	No	No	No	Yes
Performancef eedback do	Yes	No	Yes	Yes
Rcontingent compensations	Yes	No	Yes	Yes
Teaches reminders or suggestions	Yes	No	Yes	Yes
Contrato behavioral	No	No	No	No
It has preparatoryactions**tos**	No	No	No	No
Contact upon completion	No	No	No	Yes
Comparação social	No	No	No	No
Plans social support or change	No	No	No	No
Suggests being a model	No	No	No	No
Encourage the use of self-instruction	No	No	No	No
Prevents relapse	No	No	No	Yes
Stress management	No	No	No	No
Incentiva self-motivationção	No	No	No	No
Time management	No	No	No	Yes
Frequencyas of **techniques**	9	1	9	14

ASSOCIATION BETWEEN QUALITY OF APPLICATIONS AND TECHNIQUES OF BEHAVIOR CHANGES

Only two applications ("AXxion: Lost Treasure Chest" and "Looking for Bobby") had any positive and significant associations between quality and techniques of behavior changes, with correlation coefficients $\tau = 0.48$ ($p=0.01$) for both applications (Table 3).

Table 3. Correlation between the quality of smartphone applications and the techniques of behavior changes present

	Behavior change techniques	
MARCH	**τ**	***p***
AXxion: Lost Treasure Chest	**0.48**	**0.01**
Movements of gymnastics	-0.03	0.87
Looking for Bobby	**0.48**	**0.01**
Sworkit Kids	0.29	0.12

MARS: mobile app rating scale; τ: Kendall's Tau correlation coefficient; $p < 0.05$

DISCUSSION

The current study evaluated the quality, content, and techniques of smartphone applications for physical activity in children and adolescents, with significant relevance in the scientific field. The popularity and amount of mobile applications for users' health is increasing [19].

One should, however, underscore the low number of applications included in the current study. Although not detected in previous reviews, it may have happened because most have been addressed to adult targets or the general population or due to only English versions [12-16].

In the case of quality, the highest scores were reported in functionality and suggested a great concern of developers with practicalities and facility in using them [20]. On the other hand, the item information had lower scores. This is somewhat worrying since it asks whether the application considers or not the recommendations for the practice of children's and adolescents' physical activities [1, 2, 4].

Significant differences between applications have been detected for engagement and total scores. Engagement comprised the applications' qualities in fun, interest, customization, and interaction, which are determining characteristics in choosing the smartphone application. In fact, mobiles are more and more popular and smart [21, 22], indispensable [11], making possible an increase in friendship networks, their modification [23], and the range of possibilities for social networks and games [24], which delight a higher number of children and adolescents, favoring an increase in engagement.

Low scores in one of the smartphone applications (3.40 and 1.65 in users' assessment and current authors' evaluation, respectively) was the cause of such result. In fact, the other three applications were different. Although in the authors' opinion three applications mostly revealed weak to acceptable scores (2.83 ± 1.58; 2.83 ± 1.58; 3.09 ± 1.78), one application had an inadequate evaluation for engagement (1.20 ± 0.44), aesthetics (1.33 ± 0.57) and information (0.57 ± 1.13). Results would indicate a more significant limitation of one application concerning the tool used to evaluate their quality.

One should take into account that the application has been evaluated as acceptable by users and with a higher number of downloads than the other two applications. This fact may reveal that, in the case of users, other factors have to be taken into account, which may not have been considered in MARS. Further, users of such applications may have preferred only the images of the movements and functionality where the application had a maximum score in the authors' assessment.

Techniques in behavior changes are based on the theories of rational activity, planned behavior, social cognition, control, and operating conditioning [18]. However, the relationship between the quality of applications has been detected in only two applications. Similar results have been described in the literature [25] and suggest that specific techniques of behavior change may improve the perception for functionality, aesthetics, engagement, and increase in the chances for further use of a determined application. Users tend to choose applications according to their perception of design and easiness in usage [26]. One should also consider that positive relationships between the application's quality and techniques of behavior changes may be crucial for their attractiveness and greater engagement for children and adolescents [16].

CONCLUSION

Although the current study has its limitations since it evaluated available mobile applications in Portuguese, it is the first to verify the quality, resources, and techniques in applications to stimulate the practice of physical activities in Brazilian children and adolescents. Only four applications complied with inclusion criteria and could be included in the study.

As a rule, mobile applications have acceptable quality. Functionality was the most evaluated characteristic, and the issue of information had the lowest scores. In the case of techniques in behavior changes, only users' feedback was frequent for all applications, with only two presenting positive and significant association between quality and technique of behavior changes. It may be suggested that mobile application developers exploit applications based on recommendations in the literature for the practice of physical activities recommending to users the practice of at least a daily 60 min practice in moderate to vigorous physical activities. They should also propose the possibilities of children's and adolescents' behavior changes to adopt a more active lifestyle. This will surely develop into healthier behavior through an increase in the level of physical activity and a decrease of sedentary ones.

PRACTICAL APPLICATIONS

Although applications in the current study had their limitations, they may be used by teachers, school community and parents for the promotion of physical activity due to their easy use and no costs, with attractiveness and good reception by children and adolescents for such intervention through the use of electronic resources increasingly present in modern society.

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