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Implementation of a mobile app (TeenPower) to prevent overweight and obesity: Preliminary results regarding lifestyle and usability

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Abstract

The world is facing an enormous challenge: the vital need to prevent noncommunicable diseases such as overweight and obesity. Prevention programs must be not only valid and effective, but also attractive to young people. In fact, if the tool or program used is not attractive, the adherence to the treatment may not occur. The TeenPower project intended to create a platform for promoting healthy behaviors and fight overweight/obesity. This paper presents the preliminary results of the program regarding adolescents' lifestyle and the usability tests. Adolescents from three different schools in the center of Portugal were recruited. Results showed that adolescents presented moderate healthy lifestyles, with the Interpersonal Relationships subscale showing higher values. Boys presented higher values in the subscale of Interpersonal Relationships compared to girls ($p < 0.001$) and there are statistical differences between schools relating to the Stress Management subscale ($p = 0.014$). Most users made a positive assessment in terms of perception of utility, perception of ease and attitude towards the TeenPower app. Nonetheless only 33.2% of the adolescents invited activated their profile at the TeenPower app. This final assessment was important to gather information and feedback to improve future prevention programs, which should focus on motivating these adolescents and their parents to use this type of apps. In a future research it will be also important to understand the reasons for teenager's refusal to join this kind of programs.

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1. Introduction and aims

One of the main challenges that society is facing is the prevention of noncommunicable diseases such as overweight and obesity [1-4]. This is particularly important in Portugal since this country is one of the European countries with the highest prevalence of this worldwide epidemic [5].

Thus, it is of utmost importance that prevention programs use attractive and motivational tools for adolescents. This is the only way to enhance the adherence to the programs and, consequently, to have a positive impact on the therapeutic success. Therefore, those who master innovation and are able to apply new technologies in health will be better prepared to successfully face the challenges posed by the information, communication and knowledge society [6]. One of the most widely recognized models for describing the user acceptance of information technology is the Technology Acceptance Model (TAM) [7] which may be applied in the context of health information technologies [8]. This model considers the cultural and social contexts and focuses on the attributes that the technology has in increasing user acceptance.

It is within this context that the approach of the TeenPower project appears, focused on the use of intervention strategies based on Information and Communication Technologies (ICT) resources that catalyze therapeutic processes and control overweight and obesity. This project aims at helping teenagers to address healthy behaviors through surveillance, self-monitoring and social support, using a digital platform. For 24 months, a vast transdisciplinary team of researchers, health professionals and students developed the e-therapeutic system. This platform includes a mobile app in which teenagers are engaged through gamification. Preliminary studies towards the development of this mobile app can be found elsewhere [9, 10]. Five different areas were considered important since literature reinforces their relationship with the presence of overweight/obesity: nutrition, physical activity, stress, sleep and interpersonal relationships [11, 12].

The consortium of the project included nine research and teaching centers, with four co-sponsors: the Polytechnic of Leiria (ESSLei, ESECS, ESTG and ESAD.CR), the Polytechnic Institute of Santarém (ESDRM and ESSAUDE), the Polytechnic Institute of Castelo Branco (ESECB and ESALD) and the Leiria Municipality. The project was implemented in a large trans territorial area (municipality of Leiria, Santarém and Marinha Grande), exploring synergies between territorial partners such as school groups and Community Care Units. This project started in September 2017 and the mobile app was developed at the end of July 2018, and in October 2018 we started to test and implement the app in different schools.

The main aim of this paper is to present the preliminary results achieved after the multicentric implementation phase of the TeenPower project. Namely, we were looking for 2 of the main outcomes: adolescent's lifestyle and technology acceptance of TeenPower app.

2. Materials and Methods

2.1. Study design and Participants

A prevention program using an app by adolescents of three schools in the central region of Portugal was conducted. The schools were selected according to the proximity and partnerships already established previously by the polytechnics of Leiria and Santarém: one school in Leiria, another in Santarém and another in Marinha Grande. The eligibility criteria were: 1) age between 12-18 years old; 2) having provided informed consent to participate in the study as well as their parents' consent. The adolescents of the three school groups were invited to respond to three different questionnaires: sociodemographic questionnaire, lifestyle profile questionnaire and technology acceptance questionnaire.

2.2. Measures

Data was collected during 2018 from self-report questionnaires.

Sociodemographic questionnaire – Data was reported by the adolescent. It included age, gender, year of education and school location.

Lifestyle – To assess adolescent's lifestyle, youths completed the Portuguese version of the Adolescent Lifestyle Profile (ALP) [13]. This version has 36 items organized in 7 subscales: Health Responsibility (HR), Physical Activity (PA), Nutrition (N), Positive Life Perspective (PLP), Interpersonal Relationships (IR), Stress Management (SM) and Spiritual Health (SH). In each subscale, the final result varies between 1 and 4. The higher the index obtained, the healthier the lifestyle in that specific domain.

Technology Acceptance - Adolescents using the app (thus, the adolescents with an active profile) were invited to respond to a questionnaire assessing the acceptance of the technology. This 22-item questionnaire was developed by the TeenPower research team based on the HITAM (Health Information Technology Acceptance Model) [7] theoretical model, evaluating four main constructs: perception of utility, perception of ease, attitude towards the TeenPower app and behavioural intention.

2.3. Statistical analysis

Descriptive statistics are reported as means (M) and standard deviations (SD), median (Med) and interquartile range (Q1-Q3), frequencies and percentages. Comparisons between genders were performed using the t-Student test, the Mann-Whitney test and Kruskal-Wallis test if there was no normality distribution or homogeneity of variances. A p-value less than 0.05 was considered statistically significant. Cronbach's alpha was calculated to estimate the reliability and internal consistency of the scales. All analysis were performed in SPSS IBM statistics 23.

3. Results

3.1. Adolescent's Lifestyle

In this study participated 359 teenagers. The majority of the sample was from the 7th and the 8th grade (n = 331, 92.2%) and was female (n = 116, 53.2%). Regarding the school, the majority of the adolescents belonged to a school in Marinha Grande (n = 184, 52.7%), followed by a school of Santarém (n = 107, 30.7%) and finally, from a school of Leiria (n = 58, 16.6%). Regarding the Adolescent's Lifestyle scale, it presented a high internal consistency ($\alpha = 0.887$), with reliability values ranging from 0.513 (Stress Management) to 0.784 (Spiritual Health). Table 1 presents more information regarding the alphas, means, standard deviation, median and interquartile range of each subscale.

Table 1. Internal consistency values for the "Adolescent Lifestyle Profile" (ALP) questionnaire and descriptive statistics of the subscales and the total.

	Health Responsibility	Physical Activity	Nutrition	Positive Life Perspective	Interpersonal Relationships	Stress Management	Spiritual Health	Total
Alpha	0.747	0.779	0.565	0.706	0.536	0.513	0.784	0.887
M±SD	2.35±0.60	2.80±0.69	2.90±0.46	3.08±0.65	3.14±0.55	3.05±0.54	1.84±0.70	2.73±0.38
Med (Q1-Q3)	2.3 (1.8-2.8)	2.8 (2.2-2.4)	2.9 (2.6-2.1)	3.3 (2.5-3.8)	3.3 (2.8-3.5)	3.1 (2.6-3.6)	1.6 (1.2-2.4)	2.7 (2.5-3.0)

Adolescents reported higher values in the Interpersonal Relations subscale and lower values in the Spiritual Health subscale.

Regarding gender, total values are very close, however, girls reported higher values in the Interpersonal Relationships subscale and there is a statistically significant difference ($p < 0.001$) compared to boys. Boys reported higher values for the Positive Life Perspective subscale. Both genders reported low values in the Spiritual Health

subscale. Table 2 shows the means, standard deviations, median, interquartile range and p-value for the t-test of the Adolescent Lifestyle Profile subscale divided by gender.

Table 2. Means, standard deviations, median, interquartile range and p-value of the different subscales of the “Adolescent Lifestyle Profile” questionnaire, according to gender.

		Health Responsibility	Physical Activity	Nutrition	Positive Life Perspective	Interpersonal Relationships	Stress Management	Spiritual Health	Total
Female	M±SD	2.40±0.60	2.74±0.71	2.91±0.47	3.08±0.64	3.29±0.56	3.06±0.54	1.84±0.72	2.72±0.41
	Med (Q1-Q3)	2.3 (1.8-3.0)	2.8 (2.2-3.4)	2.9 (2.6-3.3)	3.1 (2.5-3.5)	3.4 (3.0-3.8)	3.2 (2.6-3.4)	1.6 (1.2-2.3)	2.7 (2.4-3.0)
Male	M±SD	2.33±0.59	2.86±0.66	2.89±0.40	3.13±0.63	2.99±0.50	3.09±0.52	1.83±0.73	2.74±0.366
	Med (Q1-Q3)	2.2 (2.0-2.8)	3.0 (2.4-3.4)	2.9 (2.7-3.1)	3.3 (2.8-3.7)	3.0 (2.8-3.5)	3.2 (2.8-3.6)	1.6 (1.2-2.4)	2.8 (2.5-2.9)
p-value (t-test)		0.465	0.244	0.745	0.603	<0.001	0.671	0.912	0.782

Table 3 shows the means, standard deviations, median, interquartile range and p-value for the Kruskal-Wallis test of the Adolescent Lifestyle Profile subscale divided by schools. Total values are very close, however, Santarém's school report higher values in the majority of subscale. The exceptions are in the Physical Activity subscale where the school of Marinha Grande reported higher values, and in the Spiritual Health subscale where Leiria's school reported higher values. For Stress Management subscale there are statistical differences between the three schools.

Table 3. Means, standard deviations, median, interquartile range and p-value of the different subscales of the “Adolescent Lifestyle Profile” questionnaire, according to schools.

		Health Responsibility	Physical Activity	Nutrition	Positive Life Perspective	Interpersonal Relationships	Stress Management	Spiritual Health	Total
Santarém	M±SD	2.38±0.61	2.75±0.67	2.97±0.40	3.13±0.60	3.18±0.55	3.19±0.54	1.83±0.69	2.78±0.38
	Med (Q1-Q3)	2.3 (2.0-3.0)	2.8 (2.2-3.4)	2.8 (2.2-3.4)	3.3 (2.8-3.5)	3.3 (2.8-3.5)	3.3 (2.8-3.6)	1.6 (1.2-2.4)	2.8 (2.5-3.0)
Leiria	M±SD	2.29±0.61	2.79±0.74	2.76±0.49	3.13±0.69	3.12±0.69	2.94±0.60	2.03±0.84	2.70±0.46
	Med (Q1-Q3)	2.2 (1.8-2.8)	3.0 (2.2-3.4)	2.9 (2.4-3.2)	3.0 (2.5-3.8)	3.0 (2.5-3.8)	3.0 (2.5-3.6)	1.8 (1.2-2.8)	2.6 (2.4-3.2)
Marinha Grande	M±SD	2.35±0.59	2.90±0.46	2.90±0.46	3.06±0.66	3.14±0.54	3.03±0.52	1.78±0.65	2.71±0.40
	Med (Q1-Q3)	2.3 (1.8-2.8)	2.8 (2.2-3.4)	2.9 (2.6-3.1)	3.2 (2.5-3.8)	3.3 (2.8-3.5)	3.0 (2.6-3.4)	1.6 (1.2-2.2)	2.7 (2.5-2.9)
p-value (Kruskal-Wallis test)		0.655	0.692	0.110	0.721	0.795	0.014	0.211	0.544

3.2. Technology Acceptance (TeenPower App)

All adolescents from the 7th and the 8th grade were invited to register for free at the TeenPower app. Of these, 107 adolescents (33.2%) activated their profile, with the majority (50.5%) being female. 47 adolescents, 27 (57.4%) female and 20 (42.6%) male, answered the questionnaire, presenting a mean age of 12.94 (SD = 1.11) years. The questionnaire presented a high internal consistency, with a Cronbach alpha of 0.935 (table 4).

Regarding the technology acceptance scale, it presented a high internal consistency ($\alpha=0.935$), with reliability values ranging from 0.798 (perceived usefulness) to 0.893 (perceived ease of use). Adolescents presented a positive perception of the TeenPower mobile app in all parameters, with the perception of ease presenting a mean of 4.10 (SD = 0.72), the perception of utility mean being 3.90 (SD = 0.72), attitude towards the TeenPower with a mean of 3.92 (SD = 0.77) and the behavioural intention subscale with a mean of 3.74 (SD = 0.87). Table 3 presents more information about the technology acceptance scale.

Table 4. Internal consistency values for the "Technology Acceptance" questionnaire and descriptive statistics of the subscales and the total.

	Perceived usefulness	Perceived ease of use	Attitude towards TeenPower	Behavioral intention	Total
Alpha	0.798	0.893	0.884	0.812	0.935
M±SD	3.897±0.717	4.101±0.722	3.915±0.772	3.738±0.865	3.954±0.635
Med (Q1-Q3)	4.0 (3.7-4.5)	4.4(3.9-4.5)	4.0 (3.4-4.6)	4.0 (3.3-4.3)	4.1 (3.6-4.3)

Regarding gender, total values are very close. However, girls reported higher mean values in all subscale and there is no statistical difference ($p < 0.001$). Table 5 shows the means, standard deviations, median, interquartile range and p-value for Mann-Whitney test (there was no normal distribution neither homogeneity of variances) of the Technology Acceptance subscale divided by gender.

Table 5. Means, standard deviations, median, interquartile range and p-value of the different subscales of the "Technology Acceptance" questionnaire, according to gender

		Perceived usefulness	Perceived ease of use	Attitude towards TeenPower	Behavioral intention	Total
Female	M±SD	3.920±0.516	4.190±0.358	3.948±0.622	3.889±0.585	4.020±0.390
	Med (Q1-Q3)	4.0 (3.7-4.3)	4.3 (4.0-4.5)	4.0 (3.4-4.6)	4.0 (3.3-4.3)	4.1 (3.7-4.3)
Male	M±SD	3.867±0.939	3.981±1.030	3.870±0.954	3.533±1.126	3.864±0.869
	Med (Q1-Q3)	4.0 (3.3-4.5)	4.4 (3.5-4.7)	4.0 (3.3-4.6)	3.8 (3.0-4.3)	4.1 (3.4-4.5)
p-value (Mann-Whitney test)		0.778	0.642	0.922	0.440	0.914

4. Conclusions

The TeenPower app is a tool to fight what has already been considered as the epidemic of the XXI century: the presence of overweight and childhood obesity [14, 15]. Unfortunately, the programs aiming at fighting obesity are not presenting the desirable results, much due to the adolescents' difficulty in joining them. Thus, and considering that new technologies are part of the daily life of adolescents, this project intended to create a platform that would be interesting and appealing to Portuguese adolescents [16]. Adolescents were constantly consulted during all phases of the project [9]. The project intended to evaluate the health status of adolescents, their cognitive-behavioral indicators, as well as to analyze the acceptance of the technology itself. This study was intended to present some of these results.

Regarding the adolescents' lifestyle, the results showed that, on average, the adolescents presented moderate healthy lifestyles, with the Interpersonal Relationships subscale showing higher values. This result reinforces the importance of this variable in the lives of these adolescents and justifies the importance of being present in prevention programs. This subscale relates to the use of communication to achieve intimacy and closeness to others. In order for communication (verbal and non-verbal) to be as less contradictory as possible, it is important that prevention programs take this component into account. Assessing adolescents' behaviors and lifestyles is important since it can help planning future interventions so that they are as appropriate as possible, meeting the needs of young adolescents.

As regards to the usability tests, only 33.2% of the adolescents invited activated their profile at the TeenPower app. In terms of perception of utility, perception of ease and attitude towards the TeenPower app, most users made a positive assessment. The app has been rated as being useful for a healthier life and as having relevant information. The adolescents also rated the TeenPower app as an easy-to-use app. Adolescents reported that the app allowed them to have greater self-responsibility and health monitoring, which meets one of the goals of the creation of the app. The final evaluation was important for the TeenPower team since it enabled the researchers and health professionals to gather pertinent information and feedback to improve in the future. The introduction of gamification, games and interactive videos with food recipes and videos with physical exercises are important targets for the future.

Thus, it seems that one of the most important issues to take into account in future studies is the importance of motivating these young people to join prevention programs and try to understand the reasons for their refusal to join

the program. In fact, and as noted earlier, only 33.2% of the invited teenagers joined the app. Those who joined, however, gave a positive assessment to it. The next prevention programs should work to motivate these adolescents to use this type of apps. It will also be important to motivate (and persuade) their parents of the importance of this type of program so that they will allow their children to install a secure app with information that is not only relevant, but also scientifically correct.

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