

Wello: The impact of a weight loss summer camp on antropometric measurements in overweight and obese children

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Abstract. Introduction: Childhood obesity is one of the significant health problems due to its adverse health consequences in the short term and further impact on morbidity and premature mortality in adult life. The main objective of this study was to assess the effect of a summer camp, in which a mobile app was used, on anthropometric measures and body fat percentage in overweight and obese children. Methods: The Wello camp was set in a rural location, over a period of 15 days, between the 18th of August and the 1st of September 2019. Children between 7 and 17 years old with a body mass index in the 85th percentile and more were included. During the camp stay, a healthy lifestyle was promoted through outdoor physical activities, interactive lessons of healthy nutrition, and personal development training sessions, under the supervision of qualified staff. The Wello mobile app, based on gamification, enhanced the learning experience and tracked participants' progress through nutrition learning games and physical challenges. Weight, height, body fat percentage, body circumferences (waist, arm) were recorded on the first and last day of camp. Results: 44 children with a mean age of 11.47 (± 2.06) years were included in the study. The majority, 53.5% of the participants were males. Between the first and last day of camp BMI decreased by 0.91 ± 1.49 kg/m² ($p < 0.05$), weight by 2.45 ± 2.8 kg ($p < 0.05$), mean body fat percentage with 1.41 ± 0.45 % ($p < 0.05$), waist circumference decreased by 2.74 ± 3.6 cm ($p < 0.05$) and arm circumference decreased by 1.16 ± 1.31 cm ($p < 0.05$). After six months, at the follow-up, the increase in BMI was 0.26 ± 2.37 kg ($p = 0.48$). Conclusions: In the short term, the Wello Camp, in which the Wello app was used, was effective in decreasing BMI, weight, body fat percentage, waist, and arm circumferences.

Key Words: Children, Overweight, Weight loss, Camp, Mobile App

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Introduction

According to the World Health Organisation (WHO), overweight and obesity are described as medical conditions in which abnormal or excessive fat accumulates and presents a negative effect on health (WHO). In 2016 it was estimated that Over 340 million children and adolescents aged 5-19 were overweight or obese (WHO, Bentham 2017), and it is predicted that by the year 2030, the number of obese children will rise. Childhood obesity is known to cause adverse health consequences in the short term and increases morbidity and premature mortality in adult life (Reilly et al 2011). To reverse this upward trend, multi-layered, modern, and innovative solutions are needed to address the issue of childhood obesity.

Prior research has demonstrated that summer camps designed to help overweight children lose weight have shown short term effectiveness (El Mikati et al 2020; Williams et al 2019; Kohlstadt et al 2016; Jennings et al 2016; George et al 2015). The advantage of this approach is that it provides a controlled environment in which trained staff can help the children improve their weight and self-esteem and also to facilitate their understanding of the causes and the consequences of obesity.

Most of the obese children summer camps that focus on weight loss include in their curricula activities like personal development training sessions, a wide range of physical activities, and nutritional education, including cooking classes.

Gamification is a new concept, described as the application of game design principles in non-gaming contexts. Potentially wide applications of gamification are observed in settings such as sustainability, government, transportation, education, and health-care, among others (Robson et al 2015). Studies have shown that it can have a positive impact on health and wellbeing, especially for health behaviors (Johnson et al 2016). An example of a menus and games that are found in a mobile app based on gamification can be seen in Fig. 1.

Based on the above mentioned, the Wello app was designed to improve the quality of life of overweight and obese children. The Wello app is an artificial intelligence nutrition platform addressed to children and their families. The app uses the concept of gamification to improve user engagement and learning. It provides children with physical challenges and nutrition learning games to increase the amount of exercise that they will undergo and to increase their healthy lifestyle knowledge. The

Table 1. Anthropometric measures on the first and last days of Wello Camp^a

Measure	First Day	Last Day	Differences	p
BMI (kg/m²)	26.19 ± 5.22	25.28 ± 4.83	0.91 ± 1.49	<0.01*
Body fat (%)	28.47 ± 7.07	27.06 ± 7.01	1.41 ± 0.45	<0.01*
Weight (kg)	65.99 ± 19.79	63.53 ± 18.45	2.45 ± 2.8	<0.01*
Waist (cm)	88.35 ± 15.53	85.6 ± 14.6	2.74 ± 3.6	<0.01*
Arm (cm)	27.74 ± 4.30	26.58 ± 3.91	1.16 ± 1.31	<0.01*

Abbreviations: BMI, body mass index; ^aValues presented as mean ± standard deviation; *Statistical significance with p<0.05

Table 2. The BMI in the last day of Camp and on Follow-up^a

	Last day of Camp	After 6 months	Difference	p
BMI (kg/m²)	25.28 ± 4.84	25.54 ± 5.36	0.26 ± 2.37	0.48

Abbreviations: BMI, body mass index; ^aValues presented as mean ± standard deviation



Fig. 1. Example of menus and games found in a gamification based mobile app

child's application is interconnected to the parent's so that the former can receive in real-time the progress and the child's activity during the day and know when the child is more active and burning the most calories, what challenges he or she accepted, and their preferences. Also, in the mobile app, children can choose a superhero avatar (Wello).

The main objective of this study was to evaluate the effect on anthropometric measures and body fat percentage of a summer camp designed for overweight and obese children and in which a mobile app was used.

Material and methods

We conducted an interventional, analytic, prospective, cohort study.

The Wello camp took place over 15 days, between the 18th of August and the 1st of September 2019, at a rural location in the North-West region of Romania.

The camp was designed for children age between 7 and 17 years who had the body mass index (BMI) in the 85th percentile and more related to gender and age. The World Health Organisation percentile charts for 5 to 19 years children and adolescents were used to assess the percentile inclusion. Children known to have food allergies or other medical conditions besides increased weight were excluded. The camp was sponsored by the Cluj-Napoca City Hall, Kaufland Romania (a hypermarket chain), and co-financed by the European Regional Development Fund

through the Competitiveness Operational Program 2014-2020. The camp was free of charge for all participants.

Weight, height, body fat percentage, body circumferences (waist, arm) were monitored on the first day of camp, after arrival, and on the departure day (day 15). The Beurer BG51XXL electronic scale (Uttenweiler, Germany) was used to measure weight and body fat percentage. BMI was calculated using the formula $BMI = \text{weight (Kg)} / (\text{height (m)})^2$, and circumferences were measured in centimeters (cm).

During the camp stay, a healthy lifestyle was promoted by performing outdoor physical activities and sports under the supervision of two yoga instructors and three personal trainers. Lessons of healthy nutrition were taught by nutritionists that were part of the camp staff, under the coordination of a physician specialized in diabetes, nutrition, and metabolic diseases. Also, personal development training sessions were performed by two psychologists.

Besides the mentioned activities, to increase the camp's effectiveness, the Wello app was used. The app was installed on each child's mobile phone and was connected to an activity tracker, Xiaomi MI Band 2 (Beijing, China), acquired through the European Fund. The combination between the app and the tracker also monitored the child's progress during the camp stay, and the number of steps walked. Food was provided on-site by one of the sponsors and was according to the concepts taught in the nutrition lessons.

After six months from the last day of camp, a follow-up was conducted. We contacted the parents that agreed for their children to be part of the study, to provide us with information on the current weight and height of the children. Also, we asked the parents if they found their child's presence at the Wello Camp useful.

The study protocol was approved by the Ethics Committee of The Podiatry Clinic Cluj and was conducted according to patients' rights established by the Helsinki Declaration of 1975, revised in 2013. All the data acquired from the participants were included in the study only after the children and their parents agreed to participate, and their parents signed the informed consent. Participation in the study was entirely voluntary, and no incentives were provided to the child or parents.

Statistical analysis was performed using the R statistical software. The paired-sample t-test was used to determine the differences

between the baseline and endpoint parameters or the follow-up. A p-value <0.05 was considered statistically significant.

Results

Of the 56 children that took part in the Wello Camp, only for 44 of participants their parents agreed to use the assessed data in this study. The mean age of the participants was 11.47 ± 2.06 years, with a minimum age of 7 and a maximum of 17 years. The majority, 23 of the children, were male participants (53.5%). The differences in anthropometric measurements and body fat percentages between the first and last days at camp are presented in Table 1. According to the mobile app and the activity tracker, the mean number of steps each child walked during the entire camp stay (15 days) was higher than 290000. The differences in BMI between the last day of camp and the follow-up 0.26 ± 2.37 kg/m² are presented in Table 2. The differences are not statistically significant.

After six months of follow-up, the parents of 43 children out of 44 found the experiences in Camp Wello useful for their children.

Discussions

Due to the upward trend of childhood obesity prevalence, there is a need for innovative and effective interventions that tackle this global health issue.

The data from this study suggests that a weight loss camp in which a mobile app was used in addition to the typical weight-loss interventions represented by increased physical exercise, nutrition lessons, and personal development classes, can be effective in the short term in reducing the weight of the participants. Studies have shown that summer camps with structured programs designed for children to lose weight can be useful (El Mikati et al 2020, Williams et al 2019, Kohlstadt 2016, Jennings 2016, George 2015). Compared to our findings El Mikati had a decrease in BMI of 0.8 ± 0.7 kg/m², but emphasize was more on healthy behaviour, not weight loss and the program lasted for 6 weeks and included an assessment of cardiovascular and physical fitness.

Although our results are similar to those of other studies, that assessed weight loss summer camps, and were published earlier, this is the first study, to our knowledge, that used, besides the common approach of a weight-loss camp, comprised of a combination of physical exercise, nutrition lessons and personal development training, a mobile app based on artificial intelligence to assist in the monitoring of the children and to provide them with physical challenges and nutrition learning games.

At the six months follow-up, their increase in BMI was not statistically significant. This finding could be related to the skills and knowledge acquired during the camp stay, but unfortunately, the nutrition knowledge acquisition, obesity prevention and self-awareness were not quantified at the beginning or at the end of the camp stay or at the follow-up. Future weight loss camps must take into consideration standardized assessment inquiries for each of the weight-loss interventions that are included in the camp's curriculum.

Due to the lack of a control group that included children that did not use the mobile app during their camp stay, we cannot assess the impact of the mobile app alone in decreasing the children's anthropometric measurements and body fat percentage. Even

though the children's BMI did not significantly increase at the six months follow-up, there is not enough data collected to be able to find a significant link between long term positive effects and the Wello camp or the mobile app. Further standardized research is needed to assess the positive impact of technology-based interventions, such as artificial intelligence mobile apps designed to decrease childhood obesity (McMullen 2020).

Conclusions

The Wello Camp, designed for overweight and obese children, in which, besides physical activities, nutrition lessons, and personal development, the Wello App was used, was effective in the short time in decreasing their body fat percentage and anthropometric measures (weight, BMI, arm and waist circumferences).

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Conflicts/ Competing Interests

None reported