

Gamified Wearables in Obesity Therapy for Youth

Completed Research

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Abstract

Introduction: Obesity in children has become a global phenomenon. Most of the existing programs have only limited effects and often require an expensive and laborious multi-professional therapy. The aim of this study was to examine which guidelines for gamified wearables can be developed into an effective tool for weight loss and long-term behavior changes within children.

Methods: The paper comprises a literature analysis and qualitative research design. Open-ended questionnaires were distributed to 3 clinicians and 18 children and analyzed using MaxQDA. Three independent variables age, gender and BMI were considered.

Results: The research has identified four fundamental guidelines for gamified wearables for which a prototype was developed. These guidelines are in short: practical obesity management tool, appealing game-approach, challenging rewards and positive education. Personal emotional support was theoretically a fifth guideline but is not supported. Results could not reliably answer whether long-term behavior change can be triggered through gamified wearables.

Keywords

Digital health; child obesity; gamification; wearables; gamified wearables; e-health

Introduction

In recent years increase in body weight and obesity have become a widespread, prevalent societal problem. It is now recognized as an official chronic disease by the A.M.A and WHO.¹ One particular novel concept that helps to promote healthy lifestyles and can fight obesity is gamification, where the treatment of obese clients is supported through the use of video and online games or apps with game elements. Another promising concept is the use of wearables. Tracked health related data can promote and enhance a healthy lifestyle but currently there is very little research available regarding the effectiveness of gamified wearables to reduce obesity in children, although several studies (Spil et al. 2017, Tong et al.

¹ http://www.who.int/dietphysicalactivity/media/en/gsfes_obesity.pdf & American Medical Association, "Obesity as a disease," Policy Statement, vol. 420, no. 13, pp. 6–18, 2013, <http://www.ama-assn.org/assets/meeting/2013a/a13-addendum-refcomm-d.pdf>

2015, Zhao et al. 2016a, Zhao et al. 2016b) suggest that the two concepts combined can lead to positive outcomes.

Obesity leads to other chronic diseases such as diabetes or cardiovascular problems the major cause of morbidity worldwide.² Obesity is a financial burden to the economy of the healthcare system as well as the clients. It results in delayed skill acquisition in educational and cognitive abilities of children as young as three years old (Cawley, 2010).

The national center for health statistics in the USA has published results indicating that the worldwide prevalence of obesity is rising steadily and has more than tripled since 1970, especially among children and adolescents (Ogden et al., 2006). Thus childhood obesity can be considered as one of the most serious public health challenges in the 21st century. Thorpe et al. (2004) stated that this fact explains 27% of the increase in health care expenditures between 1987 and 2001.

According to the estimates of the WHO (World Health Organization), from a global perspective, the number of overweight or obese children (0 – 5 years old) in 2015 was more than 42 million. WHO currently estimates the number of overweight or obese infants and young children globally to increase to 70 million by 2025.³ As obesity in children is generally associated with a higher chance of premature death, disability in adulthood, and serious consequences regarding psychological health, there needs to be numerous effective intervention programs that aim at helping children, adolescents, and adults with obesity (Dietz, 1998; Kelishadi & Azizi-Soleiman, 2014). Despite these intervention programs the number of obese children is increasing at a steady rate. The question that remains is, how can existing obesity intervention programs be successfully augmented?

A recent field aimed at helping to reduce obesity is the field of digital health. In principle the concept of gamified wearables is a novel approach to motivate people to promote a change through the use of gaming elements which have been repurposed to engage the user playfully in a non-game context (Deterding et al., 2011).

Therefore, the purpose of this study is to gain insight in the value of gamified wearables for in obesity therapy for youth by studying fundamental guidelines for such gamified wearables. The research question is: What are fundamental guidelines for gamified wearables to accomplish weight-loss and long-term behavior change in overweight and obese children and adolescents? First, based on a rigorous literature study, we present five fundamental guidelines. Second, we conduct interviews with clinicians and clients to ask their perception and experiences about the acceptance and effectiveness of these guidelines. Third, based on an in-depth analysis of the interviews, we conclude with four guidelines which are according to the literature study and interviews with the two main stakeholders in obesity treatments fundamental for the success of gamified wearables.

Literature Review

A rigorous literature review, a five-stage process based on the grounded theory approach as proposed by Wolfswinkel et al. (2013), is conducted to identify fundamental guidelines.

Obesity in Children

First and foremost, it is necessary to define the term obesity. According to WHO, “Obesity is abnormal or excessive fat accumulation that may impair health.”. Obesity, regardless whether the patient is an adult or child is the result of a chronically high calorie intake where more calories are being consumed than expended daily (Pulgarón, 2013).

Ebbeling et al. (2002) who reviewed many studies regarding obesity in children name insufficient physical activity and excessive calorie consumption as cause for childhood obesity. They argue that the parent-child interactions and home environment have changed over the past decades and this affects the lifestyle and behavior of children related to the risk of obesity.

Childhood obesity comes with considerable consequences for both the (1) individual and the (2) economy. From the perspective of the patient, childhood obesity can have substantial physical,

² <http://www.who.int/mediacentre/factsheets/fs311/en/> & http://apps.who.int/iris/bitstream/10665/148114/1/9789241564854_eng.pdf

³ ebd

psychological, and psychosocial consequences in the near and distant future (Ebbeling et al., 2002; Han et al., 2010). Bjørge et al. (2008) and (Must et al., 1992) among many others have studied the relation between childhood and adolescent obesity, and increased adult morbidity and mortality.

Singh et al. (2008) reviewed and examined publications and found the likelihood for obese children to grow into overweight and obese adults is moderate for overweight and obese youth. This indicates that obesity is a chronic disorder which is in need of persistent management and efficient treatment (Han et al., 2010).

It becomes clear from corresponding academic and scientific literature that smartphones and wearables pose as two burgeoning device categories that yield the power to promote healthy lifestyles and enhance treatment (Spil et al., 2017), which is the goal that clinicians would like to achieve after the initial intervention program.

Gamified Wearables

Zhao, Etemad, and Arya (2016) investigated to what extent the three general fields (1) Serious Gaming & Gamification, (2) Wearable Technologies and (3) Health and Fitness combined can help to enhance traditional obesity intervention. The investigated target field is thus the overlap of these three fields, named gamified wearables. Therefore, it is important to determine, similar to Zhao, Etemad, & Arya, (2016), Wortley (2015) and Zhao, Etemad, Whitehead, et al. (2016) to what extent wearable technologies can be utilized for interaction with gamification and whether that idea is feasible, motivating, and engaging. Spil et al. (2017) assessed in their publication that people have a positive attitude towards wearables and gamified health apps in general, but the adoption and usage rates of wearables are still relatively low especially in comparison to the adoption and usage rate of gamified health apps. Nonetheless, people show an increasing interest in wearables and their usefulness. Gamified apps are already a widely-accepted concept but the Spil et al. (2017) results have shown that users show increasing doubts over the physical data quality. As has been already established by Spil et al. (2017) through the use of gamified wearables these doubts could be eliminated, thus the quality of the gathered data would increase. Tong et al. (2015) also suggested that game-based approaches can be utilized to encourage and promote physical activity and lifestyle improvement. Within the serious gaming and gamification an incentive approach is being applied where virtual and physical rewards are set to decrease obesity and increase quality of life. Tong et al. (2015) stated that the effectiveness of research prototypes which use 'gamified wearables' are rarely investigated. Zhao, Etemad, and Arya (2016) developed a pilot prototype based on their findings. The case-study found that based on their results it can be said that existing technologies do match the current user needs. Indicating that the idea of deploying gamified wearables for exercise and fitness is feasible, motivating, and engaging.

Another case study regarding gamified wearables was carried out by Wortley (2015) over a time period of 2 years. He investigated the use of the wearable bracelet, Jawbone UP, which measured and collected data regarding physical activity, ones' sleep cycle, and calorie consumption (manual entering of nutrition data) and displayed the data within a free mobile application that gave feedback and visual support. The main conclusion Wortley (2015) drew from his own study was that disruptive technologies like gamified wearables, which provide accurate data measurement, feedback and smart coaching, e.g. in form of games, can create an engaging experience that yield the power to influence behavioral change. It has to be noted that the study was applied to adults. Therefore, it would be interesting to see whether same results could be achieved with children. Since the original draft of his publication Wortley (2015) was involved in several gamified wearable projects. Among others the PEGASO project⁴ which investigated the use of wearables and gamified apps to encourage and enable healthy lifestyles amongst teenagers.

When reviewing existing literature, it becomes evident that there have been several attempts to develop and implement gamified wearables to achieve weight loss, to raise realistic awareness of physical activity and calorie consumption (Ahtinen et al., 2010; Kniestedt & Maureira, 2016; Tong et al., 2015; Xu et al., 2012; Zhao, Etemad, & Arya, 2016).

Tong et al. (2015) has published a paper in which he states that utilizing a gamification strategy for an app together with a wearable, can promote physical activity and substantially improve quality of life. In his paper he described a research prototype named "FitPet" which introduced the design of such a potential

⁴ <http://www.pegaso4f4.eu/>

mobile game. A follow-up study could expose important issues such as how such games and systems can be effectively implemented into the everyday life and cast some light onto the user's reaction towards interactive games. Tong et al. (2015) have applied the mentioned game mechanics and dynamics from Zichermann and Cunningham (2011). Through its accelerometer, the smartphone records steps one takes in real-time. The step data can be converted into coins, so with each step coins can be accumulated which can help to maintain a healthy pet. Similar, Kniestedt and Maureria (2016) proposed a concrete game, the Little Fitness Dragon (LFD), which is a game for smartphones and smart-watches. It can work as a self-standing app or in combination with a smart-watch to track and motivate the players to be physically active. Kniestedt and Maureria (2016) were not yet able to test the validity of the LFD but could evaluate the interest in the game design from their target audience. Byrne et al. (2012) showed within his randomized field experiment with 39 adolescents in the U.S. that virtual pets can influence changes in behavior. Xu et al. (2012) project AHPC is a competition game to increase physical activity for adolescents and consists of a wearable pedometer, web-based game, and personal feedback. The game challenge was intended to change physical activity behavior. Consequently, the results of the study focused only on increasing adolescent physical activity, not direct weight loss. The challenge was a multi-month school-based competition in form of a virtual race against other participating schools within the United States. The pupils had wearables which counted their steps and the earned points into an online platform. Each student contributed to their school's rank and were notified via a virtual achievement reward about their progress and points. Xu et al. (2012) results indicated that the AHPC in fact did increase physical activity of students but that the effectiveness reduced over time especially in students who participated for a long period. The authors believe the justification lies within the design scope of the gamified wearable, as interest cannot be sustained over a long-time period. As has become evident, gamified wearables are a major field of research and discussion within the realms of the healthcare system. Current research has already revealed several issues, especially to maintain the users interest over a longer period.

Based on this literature review, we present five fundamental guidelines for gamified wearables for obesity therapy for youth.

1. Practical obesity management tool:
Visually edited data helps to support self-improvement due to a learning curve.
2. Appealing game-approach:
Gamified Apps encourages physical activity and trigger lifestyle improvement.
3. Challenging rewards:
Virtual and physical rewards decrease obesity and increase life quality.
4. Personal emotional support:
Virtual motivational reminders create engaging experiences and provide support that eventually trigger behavioral change.
5. Positive education:
Nutrition and exercise and well-being education have a positive effect on body weight.

Empirical Analysis

Objectives

Next in our study, we interviewed the most involved stakeholders in obesity therapy for youth, clients and clinicians, about their perception of the acceptance and effectiveness of these guidelines. The objectives of this empirical study are to gain insight in the relevance of the guidelines.

Methodology

We conducted qualitative interviews with 18 overweight and obese children and adolescents, and 3 clinicians that work within the realms of interventions to achieve weight loss and long-term behavior change for the clients.

The qualitative analysis method follows the grounded theory approach as first proposed by Glaser and then Strauss in the 20th century, and the framework Matrix of Miles and Huberman (1994). In grounded theory one starts with a very concrete and contextual vision and then, based on interviews and emerging answers, underlying explanations can be revealed. The underlying explanations are revealed by obtaining

and analyzing in-depth data. Eventually an evolving theory will develop from the corpus of used data. The advantage of the applied qualitative method is that detailed backgrounds of the interview subjects can be disclosed to enrich the information and the results which is needed because the theoretical guidelines are not established yet. In the future also quantified studies are needed for empirical validation.

The results have been obtained by means of a computer-based qualitative data analysis software, MAXQDA, by a two-step set of coding processes: substantive and theoretical coding. In substantive open axial and selective coding is applied. The goal is to produce categories and their properties. Theoretical coding weaves the substantive codes together into a hypothesis and theory (Glasser & Strauss, 1967; Strauss, 1987; Walker & Myrick, 2006).

Design & Data Collection

The client questionnaires were distributed in Germany and the Netherlands. The personal conversation lasted between 10-15 minutes. Clinicians, questionnaires were distributed in Germany and the Netherlands. These personal conversations lasted between 45 – 60 minutes. Questionnaires were also answered by mail. The questionnaires for the clinicians were kept general, as the clinicians were asked to elaborate on their own experience and difficulties within obesity therapy. The questionnaires were built upon the identified critical guidelines of the literature analysis.

In the first part the clinicians were asked to describe the intervention program they work with. This introduction directly led to the central and crucial discussion of the interview and the main question of the paper. What are the issues that arise within therapy? What are the best tactics and tools to handle these issues? And which parts of the therapy need improvement?

Here clinicians gave in-depth opinions and experiences that revealed various problems. The interview guide for the overweight and obese children and adolescents covered a sports, nutrition, and technology section which was intended to detect the attitude of clients towards the use of gamification and wearables within obesity treatment. This included input from both the interviews with the clinicians, as well as extended literature review.

To generate valid results 18 overweight and obese children between the age of 11 and 16 with a BMI between 25 and 52 were interviewed. The characteristics can be found in the Matrix below.

		BMI		Gender	
				Boys	Girls
Age	11 - 13	Overweight	25-30	3	4
		Obesity Grade 1 (slight obesity)	30-35	1	2
		Obesity Grade 2 (obesity)	35-40	2	
		Obesity Grade 3 (strong obesity)	> 40		
	14 - 16	Overweight	25-30	1	
		Obesity Grade 1 (slight obesity)	30-35	1	1
		Obesity Grade 2 (obesity)	35-40	2	
		Obesity Grade 3 (strong obesity)	> 40	1	
		Total		11	7
				18	

Table 1: Interview Matrix

Data Analysis

The transcribed interviews were analyzed by using the coding software MaxQDA. In reference to the elaborated questioning, the essential statements were coded openly and through an in-vivo method, the direct takeover of a quotation. All in all, the 18 client interviews yielded 500 codes which were assigned to categories. In the beginning, there were six main categories. During the coding process new subcategories were created and quotations assigned. Although this method of qualitative data analysis constrains generalizability, it allows developing theoretical constructs to confirm or reject existing theories. The same procedure was used for the medical professional interviews. Three interviews yielded 74 codes and were originally assigned to 5 main categories and 2 subcategories. During the coding process with the in-vivo method new categories evolved and issues within the obesity therapy were revealed. Based on Miles

and Huberman (1994) a content-analytic summary table was created which brings together all data from the interviews into a single form where all 4 target groups (based on the independent variable age and gender) are examined for their attitude towards the five fundamental guidelines.

Results

The empirical analysis revealed that all interviewed programs seem to experience the same issues when trying to change the behavior of overweight and obese children towards a balanced and well-sized diet due to a lack of intrinsic motivation. Which often rules out any chance for a long-term behavior change, resulting in weight gain after the therapy ends. Because parents often are not the role model they need to be. Clinicians indicated that lack of physical activity can be an issue. The clinicians stressed that a potential smartphone app should feature tools that motivate children to eat healthy, workout, and give them the possibility to control themselves better, and should also give them the possibility to control the everyday progress of their clients. Based on these statements children were presented several questions regarding their habits and preferences. They were also given several gamified wearable ideas for which they had to give their opinion.

Both female and male clients were open to the idea of using a wearable device if it could help them to lose weight and data also showed that clients were also in favor of the idea to use a gamified app which helps them to be physically more active and commit to a healthy diet. Clinicians have stated that children seem to have an issue controlling themselves when it comes to healthy food. The children were asked if they needed emotional support. Both female and male respondents answered that they could use some emotional support reminders in various moments throughout the day to keep up a healthy diet. The proposed monster app was not the right tool they are looking for.

When asked whether clients can estimate the caloric intake of the food they consume, all but two respondents answered negatively, and had a positive attitude towards the proposal of an electronic food diary and a picture feature to count calories on a plate. The analysis on children's attitude towards rewards for keeping up a healthy diet and increased physical activity, resulted in the fact that personal rewards or a combination of personal and virtual rewards are a good extrinsic motivator. However, it is debatable whether rewards are critical guidelines for gamified wearables. A discussion on this can be found in the following chapter. Four specific games were proposed. Regarding the monster companion which is a nutrition reminder, it can generally be stated that clients disliked the proposed monster companion game app. Three other proposed gamified wearables have received mainly positive feedback.

The content-analytical summary table summarizes all results and shows clear indication of which fundamental guidelines need to become implemented in future app development. The results for the variable BMI have been omitted due to too small sample size.

It becomes evident from the empirical analysis that clinicians believe in the potential of gamified wearables and are positive that the concept can help them to tackle the challenge of a healthy diet and long-term behavior change. The empirical analysis has demonstrated that some guidelines would be adapted enthusiastically into the daily routine by the children e.g. children have shown enormous interest in the idea of using appealing game-approach apps to lose weight and become healthy. The thought of getting displayed nutritional related data and wearing a wearable device to track health-related data, as some form of practical obesity management tool meets approval with most clients. The concept of challenging rewards did not meet the approval as assumed by clinicians or myself through existing scientific literature, which comes as a surprise. One clinician explicitly stated they successfully use the concept of rewards within their program. Three clinicians have stated that in their experience children respond well to rewards.

Critical Guidelines from the Literature Analysis	Critical Guidelines working for gamified wearables? Target Groups				
	Female 11- 13	Male 11 - 13	Female 14 - 16	Male 14 - 16	Clinicians
1. Realization of Obesity management tool	implement the guideline	implement the guideline	implement the guideline	implement the guideline	implement the guideline
Food Diary	Needed	Needed	Needed	Needed	Expressed deep interest in an accurate food diary
Picture Diary	Needed Observation: Have e expressed doubts of accuracy and functionality	Needed	Needed	Needed	n/a
2. Realization of Game-Approach	implement the guideline	implement the guideline	implement the guideline	implement the guideline	implement the guideline
Nutrition game App	not needed	Needed	Needed	Needed	Elaborated on importance of nutrition education within therapy
Sports Game App	Needed Observation: Have expressed doubts of accuracy and functionality	Needed	Needed	Needed	Elaborated on Sport being a crucial component of therapy, a successful treatment method, believe in motivation of
Competitive and Team Games	Needed Observation: Smaller focus on competition and more on team-work and friendship games	Needed Observation: A few clients have expressed wish to play alone	Needed	Needed	One clinicians has explained that team competition elements are already integrated into the therapy program. The others have expressed the strong believe in
Horse / Fighting Game	Needed Observation: Some complaints, have expressed regarding the setting of the game and competitiveness	Needed	Needed	Needed Observation: loved the competitive focus of the game	n/a
3. Realization of Rewards	Don't implement the guideline	implement the guideline	implement the guideline	guideline indecisive	implement the guideline
Nutrition Rewards	Not needed Observation: clients looking or approval of their parents	Needed Observation: In particular virtual rewards	Needed	Not needed	Believe in the power and potential of rewards, one has already integrated such feature
Sport Rewards	Neutral Observation: seems to dependent on the personality and attitude of the client	Needed Observation: Some have expressed a particular interest in personal rewards	Not needed	Neutral	Believe in the power and potential
App rewards	Not needed	Needed Observation: Some have expressed a particular interest in personal	Needed Observation: Only personal rewards	Needed	Believe in the power of rewards, one has already integrated such feature
Step Game	Neutral Observation: Seems to dependent on the personality and attitude of the client.	Needed	Needed	Not needed	n / a
4. Realization of Emotional Support	Don't implement the guideline	on't implement the guideline	n't implement the guideline	don't implement the guideline	implement the guideline
Reminders & Support in moments of doubt	Needed	Needed	Needed	Not Needed	Think that clients need a stable and safe environment with guardians reminding them to lead a healthy
Monster App	Not needed	Not needed	Not needed	Not needed	n / a
5. Realization of Education	guideline indecisive	implement the guideline	implement the guideline	implement the guideline	implement the guideline
Snack Estimation / Calories	Needed Observation: Expressed to see the benefit of extending their knowledge in this field	Needed Observation: Expressed to see the benefit of extending their knowledge in this field	Needed Observation: Expressed to see the benefit of extending their knowledge in this field	Needed Observation: Expressed to see the benefit of extending their knowledge in this field	Elaborated that it is of importance that children have an idea on nutritional value of food they consume
Nutrition game App	Not needed	Needed	Needed	Needed	Elaborated on importance of nutrition education within therapy
Hero App	Neutral Observation: Seems to dependent on the personality and attitude of the client, but is not conceived as to childish	Neutral Observation: Game should not be to childish	Needed	Needed	n / a
Results: Which Guidelines are critical to implement into the app	1,2, and maybe 5	1, 2 ,3 and 5	1,2, 3 and 5	1, 2 , 5 and maybe 3	Have expressed the necessity of a gamified wearable to include all the above named guidelines to resolve the current issues 1,2,3,4 and 5

Table 2: Fundamental App Guideline Content-analytical summary table

The clinicians and literature have indicated the importance of nutritional impact education on the degree of obesity. The data shows that positive education is wanted and needed by the clients. One theoretical guideline was not supported by the data of the empirical analysis: emotional support.

The analysis has shown that children and adolescents do not think a gamified wearable solution that is intended to provide emotional support is a helpful tool for them, thus indicating it is not an effective guideline.

It became clear that a potential app must be well structured and tailored to gender and age. Clinicians have confirmed within the questionnaire that the traditional therapies are also adjusted for age variable. Within the realms of this study there have been clear differences between preference within the variables age and gender, but often only a very slight or uninterpretable difference for the variable BMI which could be due to the small number of clients within these groups.

Discussion

The literature analysis has shown that overweight and obese children have an illogical and abnormal relation to food and meal sizes. Further, unhealthy food and more calories are being consumed in less time (Sarah E. Barlow, 2007; Cawley, 2010). This phenomenon has also been observed by clinicians, which is why they have expressed the need for an obesity management tool with a control function to access and watch the child's daily routine. The clinician's suggestion is to implement a food diary into a potential app, as the ease of food logging and exercise, will help ensure a more precise and frequent documentation of the caloric consumption and energy expenditure. Clients have expressed interest in such a tool. Children have also reacted positively towards the idea of a food photo recognition feature which would provide an easy way for children to estimate calories in a meal using the smartphone camera instead of manually entering the nutritional value of their food. There are companies currently working on such a service.⁵ Clinicians believe that parents should have access to such a tool. Literature showed that wearable devices can give access to these data points (Nelson et al., 2016; Spil et al., 2017; Zhao, Etemad, & Arya, 2016). The data analysis has revealed that children would be willing to wear such a device. Provided clinicians can have a third-party access to an app used by clients on a regular basis, this could pose as an obesity management tool with a control function. The data implies that an obesity management, in form of a food and picture diary tool, serves as a basic and effective guideline that is both requested and needed by clinicians and clients.

Clinicians and literature agree that game-approaches yield the potential to not only complement already established game elements within current therapy formats, but also motivate and encourage clients outside of therapy to behave accordingly. Gamification does indeed have the potential to engage users in normal effort tasks. Previous projects have shown that the level of physical activity can increase (Deterding et al., 2011; Xu et al., 2012). The problem is that the effectiveness can decrease over time, emphasizing that gamification needs to pique the users interest over a longer period. This can be achieved through matching skill and entertainment level. The difficulty of the game has to and new incentives have to be offered to maintain the suspension and interest in achieving new goals, and e.g. new rewards (Hswen et al., 2013; King et al., 2013). Based on the literature findings and the wish to integrate nutrition and physical activity games from the clinician's side, clients were offered several gamified wearables. Children were offered 1. A nutrition reminder app, 2. A food education game, 3. A Tamagotchi based lifestyle game for female and male patients and 4. A step-based workout game with rewards. As Cugelman (2013) has reported, it is important to assess beforehand whether gamification provides a potential tool for obesity interventions and which persuasive principles need to be applied in detail. Clinicians have confirmed that potential gamified wearables need to consider gender and age differences. Therefore, all interviews were analyzed considering age, gender, and BMI, the third variable. The purpose of this study was to gain insight in the success of gamified wearables in obesity therapy for youth by studying fundamental guidelines for such gamified wearables. The research question was: What are fundamental guidelines for gamified wearables to accomplish weight-loss and long-term behavior change in overweight and obese children and adolescents? In conclusion, it can be said that the interviews have revealed that when the 4 effective guidelines (game approach, obesity management tool, rewards and education) are

⁵ <https://www.sri.com/engage/products-solutions/food-recognition-technology> & <http://foodai.org/> & <http://www.caloriemama.ai/> & <http://www.popsoci.com/google-using-ai-count-calories-food-photos>

being applied and potential gamified wearable are adjusted for gender and age they have the potential to be good support tools for traditional obesity interventions.

Conclusion

The results have shown that gamified wearables are expected to help to manage obesity by helping clients to reduce weight.

The qualitative analysis has also revealed that triggering long-term behavior change will, despite utilizing a gamified wearable, still pose a major challenge. Rewards, according to the clinicians and literature, pose as an effective tool to entice user to remain committed to a gamified wearable. Surprisingly, it has become clear that children are not sure what they think of rewards as incentive to commit to healthy behaviors like a healthy diet and regular physical activity.

In conclusion, clinicians and patients need a multi-faceted technological solution to achieve weight-loss and enduring behavior change which will complement obesity therapy. Results indicate that the theoretical effectiveness of the guidelines will differ with age and gender of the clients. For the variable BMI results were inconclusive due to a too small number of clients within these groups. Based on this it was established that a potential gamified wearable will have to be developed for specific target groups. Further empirical quantitative analyses, ideally with a mix-method research and a bigger target sample size, are needed to confirm or disconfirm the fundamental guidelines in the future. Future studies can also explore the applicability of such gamified wearables to other chronic diseases, like Diabetes

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