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An electronic system (PDA) to record dietary and physical activity in obese adolescents; data about efficiency and feasibility

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Abstract

Introduction: **Recently, the prevalence of childhood obesity is increasing significantly. Dietary and physical activity registers are frequently referred to as the "cornerstone" of behavioral weight control programs. Mobile devices such as Personal Digital Assistants (PDAs) are showing their usefulness to facilitate these self-registers.**

Objective: **This study is aimed to analyze and compare the efficiency and feasibility of a PDA and Paper and Pencil (P&P) registers to record dietary and physical activity in a sample of Spanish adolescents with overweight.**

Methods: **Sample was composed by 30 overweight participants aged 9-15 years seeking for obesity treatment. This is a counterbalance study, all participants completing both experimental conditions: PDA and P&P registers.**

Results: **For dietary records, participants filled out more records using P&P than PDA when "total" number of self-registers was considered, but when "complete" records were taken into account, these differences disappeared, and when percentages of "complete" records were analyzed, PDA produced more accurate registers than P&P. For physical activity, PDA produced more records than P&P. PDA was the preferred system. According to participants, the PDA s strengths are the comfort, easiness to use and to transport.**

Conclusions: **Results showed that P&P produced more incomplete dietary records than PDA. PDA is a reliable system that allows the clinician to be confident in the data recorded. Recently, several applications for mobile devices have been developed, but there are few studies supporting evidence of their efficacy and feasibility in assessment and treatment of childhood obesity. This study tries to provide some evidence in this field.**

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Key words: *Childhood obesity. Self-monitoring. Information and communication. Mobile devices. eHealth.*

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UN SISTEMA ELECTRÓNICO (PDA) PARA EL REGISTRO DE INGESTA Y ACTIVIDAD FÍSICA EN ADOLESCENTES OBESOS; DATOS SOBRE EFICIENCIA Y VIABILIDAD

Resumen

Introducción: **En los últimos años, la prevalencia de la obesidad infantil se ha incrementado de forma significativa. Los registros de ingesta y actividad física son considerados la "piedra angular" de los programas comportamentales de control del peso. Los dispositivos móviles, como las *Personal Digital Assistant* (PDAs), están mostrando su utilidad en la realización de estos registros.**

Objetivo: **El presente estudio tiene como objetivo analizar y comparar la eficiencia y viabilidad de un sistema PDA y un sistema de Lápiz y Papel (P&P) para el registro de ingesta y movimiento físico en una muestra de adolescentes españoles con sobrepeso.**

Método: **La muestra estuvo compuesta por 30 niños de entre 9 y 15 años con sobrepeso que asisten a un tratamiento para obesidad infantil. Se trata de un estudio contrabalanceado, por lo que los participantes completaron ambas condiciones experimentales: PDA y P&P.**

Resultados: **Considerando los registros de ingesta, cuando se consideran los registros "totales" los participantes realizaron más registros utilizando el sistema P&P que el sistema PDA, pero cuando se consideran los registros "completos", estas diferencias desaparecieron y al considerar el porcentaje de registros "completos", el sistema en PDA produjo más registros que el sistema P&P. Respecto a los registros de actividad física, el sistema PDA produjo más registros que el sistema P&P. La PDA fue considerada el sistema preferido por los participantes. De acuerdo con las opiniones de éstos, las potencialidades de la PDA es su comodidad, su facilidad de uso y de transporte.**

Conclusiones: **Los resultados obtenidos indican que el sistema P&P produce mayor cantidad de registros de ingesta incompletos que el sistema en PDA. La PDA es un sistema fiable que permite al clínico confiar en los datos registrados por los niños respecto a la ingesta y a la actividad física. Recientemente, se han desarrollado diversas aplicaciones para llevar a cabo registros en dispositivos móviles, pero aún son escasos los estudios disponibles que avalan la eficacia y viabilidad de estos sistemas para la evaluación y el tratamiento de la obesidad infantil. Este estudio pretende proporcionar evidencia al respeto.**

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Palabras clave: *Obesidad infantil. Auto-registros. Tecnologías de la información y comunicación. Dispositivos móviles. eHealth.*

Abbreviation

P&P: Paper and Pencil self-register method.
PDAs: Personal Digital Assistants.
ICTS: Information and Communication Technologies.
EMA: Ecological Momentary Assessment.
DR: Dietary Record.
PAR: Physical Activity Record.

Introduction

The prevalence of childhood obesity has increased alarmingly in recent years[1]. Factors such as the modification of dietary and increase of sedentary activity are the mainly causes of this rapid increase. The main aim of childhood obesity interventions is to change diet and physical activity habits. Self-monitoring is a standard component of these programs. Self-monitoring techniques are useful to collect information on the patients' behaviours and they also allow evaluating the treatment's effects. At the same time, they enhance the patients' awareness of their own behaviour. Being explicitly confronted with unwanted behaviour often leads to immediate decreases of it[2]. In childhood obesity, self-monitoring techniques are used for management of dietary and physical activity and for successful weight management[3,4]. It has been found a consistent relationship between self-monitoring and success in both losing weight and maintaining weight loss[5]. Evidence show that participants loose more weight during the weeks they self-monitor. The consistency and completeness of self-monitoring are relevant in the process of weight loss[5-9].

A very common approach to self-monitoring is self-register. In obesity, the usual variables to self-register are dietary and physical activity. Regarding diets, self-registers usually ask about amount and type of food. Furthermore, it is relevant to identify behaviours, thoughts and emotions associated with intake behaviour, and the environmental circumstances surrounding it. Regarding physical activity, the variables to be registered are usually the kind, intensity and duration of activity.

Although very useful, Paper and Pencil (P&P) self-register methods possess several limitations regarding reliability and validity. The accuracy of data is questionable due to recall bias, delayed data entries and missing information[10], and in many cases are uncomfortable methods to carry out along the day. In addition, the adherence to self-register in long treatments is difficult[11]. To improve the consistence and compliance of self-register, it is important that this process be made as simple as possible[6,8,9].

Information and Communication Technologies (ICTs) and more specifically mobile devices such as mobile phones, SmartPhones or Personal Digital Assistants (PDAs) may help in solving these limitations[12,13], allowing for real time data assessment practically at any time[14], improving reliability and decreasing missing data[15]. Furthermore, when combined with the Internet, these systems permit a direct communication between patients and clinicians. Other advantage is user acceptance. Specifically, children evaluate these systems as easy, comfortable, and enjoyable[15,16].

In the field of electronic dietaries, the Ecological Momentary Assessment (EMA) has emerged as a method for the collection of self-report data on people's experiences as they go about their everyday activities[17,18]. EMA can help in reducing the limitations of traditional self-monitoring[19], and electronic forms of EMA have shown higher compliance than paper and pencil diaries[20].

Electronic EMA procedures have been used in obesity assessment and treatment, and also to better understand the relationships between eating behaviour and obesity[21]. Some studies have analyzed their efficacy to improve treatment adherence and weight loss[22-24]. Other studies have compared electronic and traditional dietaries[25,26]. Finally, several studies have analyzed the feasibility and reliability of PDAs as assessment strategies in obesity[27-30]. However, most of these studies have been carried out in adult populations. For obese children and adolescents, and to our knowledge, only two studies have analyzed the use of electronic self-registers. Cushing et al.[22] assessed the impact of the use of Personal Electronic Devices on overweight adolescents self-monitoring. Results supported their utility for improving self-monitoring but the sample was composed only by 3 overweight adolescents. Dunton et al.[29] analyzed the feasibility, acceptability and validity of an electronic EMA to assess physical activity in a sample of children at risk for overweight, but children were compensated monetarily for participating. To our knowledge, there is no study focused on analyzing the feasibility of electronic EMA using PDAs to record dietary and physical activity in adolescents with overweight under treatment and without extrinsic reward.

In addition to efficacy, before including an electronic dietary in an assessment and treatment protocol for childhood obesity it is also needed to analyze its feasibility, specifically individuals' acceptance of, and adherence to self-monitoring procedures. Saelens and McGrath[31] reported that only 20% of participants in a weight management program monitored diet and physical activity on 75% of treatment days, using P&P registers. Also, some studies have showed a declining self-monitoring over the course of treatment[32]. Furthermore, participants often report having completed their self-monitoring homework while objective measures of self-monitoring contradict these self-reports[33].

Present study is aimed at exploring the efficiency and feasibility of an electronic EMA using PDAs to record dietary and physical activity in natural contexts in overweight adolescents who are under treatment. Acceptance and perceived utility by participants are also analyzed. We also compare the electronic self-

register with traditional system and analyze the preferences between both systems.

METHOD

Participants

The sample was composed of 30 participants (14 girls and 16 boys) ranging from 9 to 15 years old (X = 12.41; SD = 1.64). Body weight was recorded to the nearest 0.1kg with the use of a standard beam balance scale TANITA TBF-410M with the participants wearing light indoor clothing and no shoes. Height was recorded to the nearest 0.5 cm by a standardized wall-mounted height board. Mass Index standard deviation scores (BMI-Z) were calculated using a program provided by Centers for Disease Control and Prevention (CDC)[34]. Regarding weight, z-scores adjusted for sex and age were calculated, being z = 2.06 (SD = 0.31). The Body Mass Index (BMI) was 29.1 (SD = 3.5).

The sample was recruited from a Child and Adolescent Cardiovascular Risk Unit, located in a public hospital specializing in childhood obesity treatments. All of them were receiving a weight loss treatment.

Instruments

- *PDA System:* A record system for PDAs was developed which include two sections: Dietary Record (DR) and Physical Activity Record (PAR). In DR, children had to introduce the food eaten, the amount and the order, social situation at the time of the intake, the place, thoughts prior to intake and the emotion that children had prior to eating. In PAR, children had to introduce the activity completed, duration and intensity. Day and hour were automatically recorded in both self-registers. The software application was developed using .net technology based on Compact Framework 3.5 for mobile devices to run on Windows Mobile operating system. For a more detailed description, see Baños et al.[35]
- *Paper and Pencil (P&P) System:* A "Notebook" was developed to assess the same variables as in PDA system, with a page for each day. Children also had to record the day and hour they did the register.
- *Questionnaire about acceptability and usability of PDA:* It was adapted from *"System Usability Scale"* (SUS)[36], and it consists of 15 items to be answered in a 1-5 likert scale (1: strongly disagree; 5: strongly agree), which asked about easiness of use and learning, complexity, and comfort. It also includes 4 open questions about strengths and weaknesses, and suggestions to improve the system.
- *Questionnaire about acceptability and usability of P&P:* It is similar to the previous one, but only 11 items have to be answered in a 1-5 likert scale. It also includes 4 questions asked about strengths, weaknesses, and suggestions.
- *Questionnaire to compare both conditions (PDAs vs P&P):* It was developed *ad hoc*, and it consists of 8 items where participants had to choose the system which was more comfortable, faster, easier to use, easier to transport, easier to learn, unpleasant, funny and useful. "Both are similar" alternative was also offered. Finally, participants were asked for the most important strength of each system.

Procedure

It is a counterbalanced study where participants completed both experimental conditions: PDA and P&P registers. It was approved by the institutional ethics committee of the Hospital General of Valencia. Data were collected between September 2008 and July 2009.

All 9-15 years old children who were to visit a paediatric service for obesity treatment during one week, were invited to voluntarily participate in the study. Once parents accepted and signed the informed consent, children were randomly assigned to one of the two conditions: a) PDA + P&P (N = 15), or b) P&P + PDA (N = 15). Each experimental condition had a week-long. Children received their first condition (PDA or P&P), a week later they returned to the hospital, and they received their other condition. A week later, children came back to the hospital and they fulfilled the questionnaires about opinion and satisfaction.

Children were asked to record any dietary and physical activity that they carry on every day during the week. Participants did not receive any instruction regarding how many self-records they should do during the week.

Results

Analysis of self-registers fulfilment

We calculated for each system (PDA and P&P), for each Records (DR and PAR), and for each participant, the total number of self-registers ("total") made along each experimental condition (1 week), and the number of self-registers per day ("daily") (Table I).

In order to analyze differences in fulfilment between both systems, t-Students were applied, using these two variables ("total" and "daily"), for the two Records (DR and PAR) separately (Table I). Regarding DR, results showed statistically significant differences for "total" ($t = 6.44$; $p < 0.001$) and "daily" ($t = 5.01$; $p < 0.001$) registers. In both cases, participants fulfilled more registers in P&P than in PDA condition.

Table I
t-Student and Pearson correlation for total, complete, percentage of complete and daily self-registers for Dietary and Physical Activity Records in both conditions

		P&P		PDA					
		M	*SD*	*M*	*SD*	*t*	*p*	*r*	*p*
Dietary Record	Total Number of Self-register	29.37	6.23	17.53	9.41	6.44	<.001*	0.28	0.14
	Complete Self-register	15.13	11.59	13.43	10.56	1.05	.30	0.65	<.001*
	Percentage of Complete Self-register	50.97	36.42	70.37	35.46	-2.82	.009*	0.46	<.001*
	Daily self-register	4.24	0.82	3.03	1.27	5.01	<.001*	0.30	0.11
Physical Activity Record	Total Number of Self-register	5.2	2.14	4.17	4.25	1.4	.17	0.36	0.05*
	Complete Self-register	4.17	2.42	4.13	4.26	0.05	.96	0.44	<.001*
	Percentage of Complete Self-register	74.96	32.98	99.07	4.81	-3.68	.001*	-0.21	0.29
	Daily self-register	1.00	0.00	1.45	0.59	-3.97	.001*		

*$p \leq 0.05$

Regarding PAR, results showed statistically significant differences only for "daily" registers ($t = -3.97$; $p < 0.001$), but in this case participants fulfilled more registers in PDA than in P&P condition.

As there were many incomplete self-registers, the frequency of "complete" self-registers fulfilment was also analyzed. A self-register was considered as "complete" when all items were answered. The same analyses were repeated, and t-Students were applied using "complete" self-registers, for the two records (DR and PAR) separately. Results did not show any significant differences in both cases, so PDA and P&P produced similar number of "complete" self-registers. To deeply analyze the different results when "total" self-registers or "complete" self-registers were taken into account, percentages of "complete" self-register and "total" self-registers were also calculated for each record (DR and PAR), and for each condition (PDA and P&P). As it can be seen in Table I, PDA condition produced higher percentages of "complete" self-registers than P&P condition for both, DR ($t = -2.82$; $p < 0.001$) and PAR ($t = -3.69$; $p < .001$).

In order to analyze the relationship in the fulfilment of both self-register systems, Pearson correlation analyses were applied for "total", "daily", "complete", and percentage of "complete" self-registers. For DR (Table I), results indicated only significant correlations in both "complete" self-registers fulfilment (total and percentage). That is, children who fulfilled more "complete" self-registers in one condition, did so in the other. However, there were no relationships between the number of daily self-registers. For PAR results indicated significant correlations in the "total" self-registers and in "complete" self-registers.

Correlation
Acceptance and Satisfaction Analysis

First, acceptance and satisfaction were analyzed separately for each system. As table II shows, participants assessed both PDA and P&P as easy to use and learn, comfortable, safe, and requiring few time to learn how to use it. The space to record was assessed as adequate and participants did not mind carrying it, and other people see how they introduce the information. Participants did not consider them as uncomfortable to carry on every day, and they would not mind to continue using them for long. To analyze significant differences between both systems, t-Students were applied for all items of acceptance and satisfaction (Table II). Results indicated significant differences in the speed ($t = -2.14$; $p = 0.04$) and in easiness to learn ($t = -2.41$; $p = 0.02$), considering P&P more agile and easier than PDA.

To analyze the relations in acceptability and satisfaction for both systems, Pearson correlation analyses were applied (Table II). There were significant and positive correlations for the perceived complexity of self-registers, the time needed for learning, and the annoyance in carrying it with them.

To analyze the relationship between self-registers fulfilment and satisfaction and acceptance for both systems, Pearson correlation analyses were also applied for all the items of acceptance and satisfaction questionnaire, and "total", "daily", "complete" self-registers, and the percentage of "complete" self-registers (DR and PAR).

For PDAs, regarding DR, there were significant negative correlations between "comfort" and the "total", the "daily" and the number of "complete" self-registers. Results showed that participants who assessed the use of PDA system as more comfortable were the participants who filled less self-register with PDA ("total": $r = -0.51$, $p > 0.01$; "daily": $r = -0.41$; $p = 0.03$; "complete": $r = -0.39$, $p > 0.04$). Furthermore, participants who were not annoyed that people saw them with PDA were the participants that filled more percentage of "complete" self-register ($r = -0.39$, $p > 0.04$). Regarding PAR, participants who assessed the use of PDA as more comfortable were the participants who filled less "complete" self-register ($r = -0.39$, $p > 0.04$).

Table II
Acceptance and satisfaction with PDA and P&P

	PDA System MD (ST)	*P&P System MD (ST)*	*t*	*p*	*r*
Easy to use	4.1 (1.3)	4.4 (0.8)	-1.28	0.2	0.28
I think most children quickly learn to use the self-register	3.7 (1.2)	4.1 (1.2)	-1.27	0.2	-0.14
I felt very comfortable and safe with the self-register	3.9 (1.3)	4 (1.1)	-0.64	0.5	0.24
Speed to do the self-register	3.3 (1.3)	3.9 (1.3)	-2.14	0.04*	0.36
The comfort of self-register	4.1 (1.2)	4,1 (1.2)	0.11	0.9	-0.19
Easy to learn	4.4 (0.8)	4.8 (0.5)	-2.41	0.02*	0.16
I don't care use the self-register for longer	4.1 (1.2)	3.8 (1.3)	0.61	0.5	-0.12
It is very complex	2.37 (1.4)	2.0 (1.2)	1.68	0.1	0.59*
It is uncomfortable to use	2.1 (1.3)	1.7 (1.1)	1.35	0.2	-0.17
I needed a long time for learn to use the self-register	1.9 (1.4)	1.6 (0.9)	1.73	0.09	0.66*
It's annoying to carry the self-register with me every day	1.9 (1.0)	2.3 (1.3)	-1.47	0.1	0.52*
Bothered me that people see me register information in self-register	1.7 (1.0)	1.6 (0.9)	0.89	0.3	0.36
I think it is necessary to increase the space to write	2.5 (1.4)	1.9 (1.3)	1.68	0.1	0.27

*$p \leq 0.05$

For P&P, regarding DR, participants who considered P&P system more "complex" were the participants who filled more "daily" self-register ($r = 0.4$; $p = 0.04$). Participants who considered P&P more agile ("speed") were participants who filled more percentage of "complete" dietary self-register($r = 0.42$; $p = 0.04$). Regarding PAR there were significant correlations between "comfort" and the "total" number of self-registers ($r = 0.53$; $p = 0.01$) and the number of "complete" self-registers ($r = 0.49$; $p = 0.01$). Participants who assessed the P&P system as more comfortable also filled more self-registers ("total" and "complete"). Finally, participants who did not mind to use it for longer were participants who filled more percentage of "complete" self-registers ($r = 0.59$; $p < 0.00$).

Regarding preferences between both systems (Table III), a third of the participants preferred PDA over P&P. Participants considered PDA as easier to transport, funnier and more useful system than P&P. P&P was considered more comfortable, quicker and easier to learn and to use than PDA. Participants considered that P&P was better in order to remind them what they have to do. Lastly, participants considered P&P more annoying than PDA.

Qualitative data

Participants' comments on the open questions were analyzed. Regarding PDA, 80% of participants answered these questions. For "The most liked" item, 29% indicated that PDA was comfortable and easy to use, 33% said that "PDA is the same as a mobile phone" (reflecting the value of being a mobile phone). For "The most disliked" item, 25% indicated that was to introduce the login and password in every self-register.

Regarding P&P, 63% of the participants answered the questions. For "The most liked" item 11% indicated the availability. Registers were always available, so participants always can see the information that they have introduced every day. They also indicated that P&P allowed them to introduce new information although the event had already been issued or even modify the previous information. 16% indicated P&P system was comfortable to introduce the information. For "The most I disliked" item, 42% indicated that they disliked writing information.

As for the comparison items between both systems, 73% of the participants answered these questions. As "PDA's strengths", 27% indicated the comfort, 14% indicated the easiness to use and 9% indicated the easiness to transport. As "P&P's strengths", 45% indicated the easiness and 23% indicated the availability. They indicated that P&P system allowed them to modify the previous information and to include more information before coming to the hospital.

Discussion

The main objective of present study was to assess the efficiency and feasibility of a PDA to record dietary

Table III
Preference between both systema

	P&P System %	*Both are similar %*	*PDA System %*
I prefer to use…	16.7	33.3	33.3
It is more comfortable	33.3	20	30
It is more quickly	43.3	10	36.7
It is more easy to use	46.7	23.3	16.7
It is easier to transport	3.3	13.3	70
It is easier to learn to use	40	26.7	20
It is more annoying	30	50	6.7
It is more fun	6.7	26.7	53.3
It is more useful	10	40	33.3
It is easier to remember that I have to do	43.3	16.7	26.7

and physical activity in a sample of overweight adolescents, and to compare PDA with P&P self-register procedures. Also, we analyzed the barriers of using an electronic system to record dietary and physical activity information.

First, our results showed some differences between dietary and physical activity records. For DR, participants filled out more records using P&P than PDA when "total" number was considered. However, when "complete" records were taken into account, these differences disappeared. Even more, when percentages of "complete" records were analyzed, PDA was even better than P&P, as mostly all records (70%) in PDA were complete, whereas only half records (50%) in P&P were complete. Thus, results showed that P&P produced more incomplete DR. A possible explanation is that some P&P records were made later (at the end of the day or at the end of the week), and this was not possible for PDA. In fact, some children stated that they were afraid to lose the PDA, as a result, they did not carry it out all day, and they registered only at home.

For PAR, results were somewhat different, as PDA produced consistently more records (total, daily, and percentage of "complete" records) than P&P. These differences between DR and PAR could be due to the "expected" number of records to be made. Although participants did not received any instruction on the minimum number of self-registers, in DR they might guess that 5 was the expected number, as they usually had 5 meals. So, if they forgot to register, they knew they had to get 5. In fact, the average was 4.24 for P&P. However they could not register late in PDAs and the average was 3.03. For physical activity, participants might guess that they had to register at least once. So, if they forgot to register, the "standard" to get was 1. In this case the average was 1 for P&P and 1.45 for PDA. This possible explanation was also supported by some comments made by participants. They indicated that the principal advantage of P&P was that they can check the information introduced and modify it or introduce new one *a posteriori*. So, when participants had to deliver the self-register systems, it is possible that they "completed" the "Notebook" just before delivering it. That is no possible with PDA, as time and data is automatically registered. Thus, although P&P can provide more DR, they could be less accurate.

Regarding acceptability and satisfaction, both systems obtained similar scores. It is important to highlight that in both systems participants had to write long information (especially food), and it could be more difficult, uncomfortable, and slower in PDA because they had to use a small "digital pencil". However, there were no differences in "satisfaction" items between both systems. Despite the lack of differences, results showed negative correlations between comfort and the number of records in PDA. The more DR and PAR participants did, the less comfortable they assessed the use of PDA. The opposite pattern was found in P&P system (positive correlation). Finally, when they compared both systems, participants considered P&P more annoying than PDA and PDA as easier to transport, funnier and more useful than P&P.

This study presents several limitations. First, the sample size is small. Second, PDAs were loaned to participants, and several children were afraid to lose them, and then they did not carry it out all day in usual contexts. This issue could limit the use of PDAs and be a barrier that makes its implementation difficult in the real context.

Results from this study point out the need to improve PDA procedures and support the suggestions made by previous studies to make the self-register process as simple as possible[6,8,9]. Our participants suggested avoiding login every time. But it is also needed to improve the usability and ergonomics, especially to register food and movement. Some alternatives could be to use ergonomic keyboards without "digital pencil", as Smartphones have recently incorporated, or that the software "guess" the word to be introduced and participants do not have to introduce all complete words. Another alternative is to record the information through voice recognition (not available at the beginning of this study). It is also possible to use images or icons, especially for DR, but it could be complex, as meals are diverse and a big library would be needed to cover all possibilities and cultural differences. Other possible difficulty is the small size of the screen (and letters) and battery discharges faster. Previous studies have pointed out other weakness of PDA, as these devices require specific maintenance and it is needed to update and adapt them to technological advances[37].

Despite these limitations, PDAs have important advantages: participants (especially children and adolescents) are already familiar with mobile phone technology. In this study, adolescents considered PDAs very useful, they liked them, and they were very happy to use them. Other important advantage is that clinicians can get updated information from patients in real time. So, they could adapt treatment to each patient. Moreover, PDAs can also reinforce healthy behaviours at the very moment that they are performed by showing rewarding messages.

In conclusion, this study shows that PDA is a reliable system that allows the clinician to be confident in the data recorded, while the P&P could produce less reliable and accurate registers, but some improvements are needed in order to be implemented in usual treatments. Health intervention should be directed towards promoting and maintaining health behavior, and PDAs are becoming an important and popular tool in health care as they offer advantages to enhance clinical practice[38]. Regarding DR and PAR, several applications have been developed in the last years, but there are few studies supporting evidence of their efficacy and feasibility in the specific field of assessment and treatment of childhood obesity. This study tries to provide some evidence in this field.

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Conflict of interest

None declared.

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