Self-Perception of Dependence as an Indicator of Smartphone Addiction. Establishment of a Cut-off Point in the SPAI-SP Inventory

María Luisa Ballestar-Tarín (M.L.B.-T.)[1], Conchín Simó-Sanz (C.S.-S.)[1,2], Elena Chover-Sierra (E.C.-S.)[1,2*], Carlos Saus-Ortega (C.S.-O.)[3], María del Carmen Casal-Angulo (M.C.C.-A.)[1,4], Antonio Martínez-Sabater (A.M.-S.)[1,5]

1 Nursing Department. Universitat de València. Facultat d'Infermeria I Podologia. Nursing Care and Education Research Group. (GRIECE)
2 Hospital General Universitario de Valencia.
3 University Nursing School la Fe. Valencia
4 Extrahospital Emergencies Service. Valencia
5 Hospital Clínico Universitario. Valencia.

* Correspondence: elena.chover@uv.es Tel.:+34-96-3864182 (E.C.-S);

Abstract: Background: In recent years, the abusive use of the smartphone has reached a situation that could be considered pathological, although there is no such classification in the DSM-IV. In this sense, different instruments to assess this problematic use or addiction to the smartphone are used. Among them, we found the SPAI, which has been validated in the Spanish language. The main difficulty of these scales is to establish a cut-off point that determines such mobile addiction. On the other hand, self-perception has been used in different addictions as a predictor of the problem.

Aim: The objective of this study is to establish the cutting point in the scores of the SPAI scale validated in Spanish, using as a referent the self-perception of addiction values.

Methods: A receiver operating characteristics (ROC) analysis was carried out, establishing as the cut-off point the one that presented a higher value of Youden J, indicative of its sensitivity and specificity.

Results: 2598 participants from the university community completed the SPAI-Spain questionnaire. When using the self-perception of smartphone addiction as the benchmark value, a score of 44 has been established as the cutting point of the SPAI questionnaire, with a Youden J corresponding to 0.416.

Conclusions: The implementation of a cut-off point of the SPAI questionnaire makes it an instrument that allows early identification of those individuals at risk of addiction as well as the establishment of preventive and/or intervention measures.

Keywords: smartphones; addiction; self-perceived addiction; ROC analysis; cutoff point; SPAI-Spain

1. Introduction

In the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), the term behavioral addiction is introduced for the first time, with the gaming disorder as the only category [1]. It is admitted, therefore, that the "pathological gambling" is an addictive disorder and not a disorder of impulse control, as it was previously classified [2,3]. The American Psychiatric Association recognizes that reward systems are activated, and similar behavioral symptoms occur in clinical conditions caused by substance use [1]. This is an open door to other behavioral addictions such as

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sex, shopping, food, work, physical exercise, mobile or technologies [4]. However, the DSM-V only points a small reference out to the existence of these excessive behaviors, calling them behavioral syndromes. They are supposed not having a solid base to be considered as mental disorders [1]. Despite this, there are many researchers who advocate for the addictive nature of these behaviors [4,5].

This study focuses on the use of the Smartphone, to which authors such as Flores et al. [6] catalog it as the consequence of the new "society of autism." The increase in connectivity in different areas of life has led to a behavioral change in people. The excessive use of network technology can lead to physical, mental and social problems [7]. This symptomatology is assimilated to substances addiction, giving rise to the lack of control of impulses, dependence, craving, anxiety, interferences in daily life, in the dream and / or in the personal relationships, among other symptoms [9]. Nowadays, the problematic use of technologies is considered a social problem, being adolescents and young adults the biggest risk group [10,11] .

Authors such as Billieux consider the "problematic mobile phones' use" (PMPU) as an inability to regulate the use of mobile phones, which eventually leads to negative consequences in daily life [12]. Studies carried out in Spain find values of PMPU that oscillate between 7.99% and 12.5% using different scales [13]. Three different ways have been established to define the problematic use of the mobile with its three respective behavior patterns: addictive pattern, antisocial pattern and risk use pattern. It is necessary to know through validated instruments and semi-structured interviews three aspects of the individual to be cataloged as a user with a real problem: the user profile, the actual use of the device and the type of problematic use made [14]. To achieve the objective of establishing diagnostic criteria for behavioral addictions, it is also necessary to develop reliable and valid measures of these behaviors and regularly assess their psychometric properties, especially because the technological and social trends related to these behaviors change rapidly [7].

In diverse studies, validated scales have been compared asking users to express their opinion regarding the risk indicated or perceived by them [15,16]. It is important to emphasize that the degree of problem recognition that anyone has is related to the valence of the content of their personal scheme related to consumption [17]. Therefore, self-perception has been widely used in different studies as an indicator of disease. In this sense, it has been evaluated some factors such as the association of self-perception with the dependence on text messages [7], the use / addiction to pornography and personality factors [18], the reasons and barriers in the search for help in gambling problems [19], risk of committing violence [16], alcohol dependence [17,20], the predictors of the change in alcohol consumption habits [21]. Even the self-perception of physical health has been related as a predictive factor in the use of health services [22] or the degree of participation in endurance sports and self-report data on self-image, physical and psychological health and style of life in general [15]. In other studies, the variable self-perception of health status, proves to be a criterion that is strongly related to the presence of chronic diseases [3].

Therefore, we performed this study with the aim to establish the cut-off point in the scores of the SPAI scale validated in Spanish [8] related with the self-perceived addiction score indicated by the participants. In addition, our intention is to verify that this criterion variable is better than other measures of dependence, such as the mobile's dedication time.

2. Materials and Methods

Design

Cross-sectional observational study developed during the month of April 2017.

The data collection instrument (in online format) was distributed among all the members of the university community (students, faculty, and administration staff) using the mailing lists of the central services of the University of Valencia as a mean of dissemination.

All persons of the reference population of legal age who were users of a Smartphone-type mobile telephone were considered as candidates to participate in the study. The participants were selected using non-probabilistic convenience sampling.

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Finally, 2958 people participated, aged between 18 and 87, 65.3% of them were women, and 34.7% were men.

Data collection instrument

The designed instrument allowed us to collect information about the sociodemographic characteristics of the population, patterns of mobile phone use and the subjective perception of Smartphone dependence, using a numerical scale (1-10); the SPAI-Spain inventory used for the analysis of smartphone addiction was also included.

The SPAI-Spain instrument [8] has shown adequate indices of internal consistency (α = 0.94), consists of 22 items, four less than its original version [24]. These items can be reduced to four factors or dimensions: craving, interference in daily life, interference in sleep or rest and tolerance. Their Cronbach's α values are between 0.766 and 0.894. Each item is answered by a Likert scale ranging from 1 (strongly agree) to 4 (strongly disagree), obtaining a global score between 22 and 88; The higher the score obtained is, the higher the degree of addiction will be.

Data analysis

Receiver operating characteristics (ROC) analysis was conducted to examine the diagnostic efficacy of the SPAI-Spain for smartphone addiction, using the area under the ROC curve (AUC). Through this analysis we compared the probability of correctly classifying a subject as an "achiever" of a certain characteristic (criterion), what we know as sensitivity of the test, with the probability of classifying as "achiever" somebody that is not (1-specificity), obtaining an optimal cut-off point, from which it would be possible to classify the largest number of subjects correctly [25].

Thus, to obtain a cutoff score of the SPAI-Spain, two variables that measure mobile phone dependence on the Smartphone, self-perception of the dependency and hours of dedication have been used as criterion variables. These two variables obtained a high correlation with the final score of the SPAI-Spain, Spearman's r 0.595 and 0.447 respectively. The variables were dichotomized, considering as "DEPENDENT" those subjects who indicated scores between 8 and 10 in smartphone's dependence self-perception and those who used their mobile 4 hours or more a day. "NOT DEPENDENT" subjects will be those with scores lower than 8 in the variable smartphone's dependence self-perception and those who used it less than 4 hours a day.

The sensitivity, specificity and Youden Index were calculated to each SPAI-Spain score. The cutoff point for the SPAI-Spain was optimal for smartphone dependence diagnosis when the score was accompanied by a high Youden Index. Subsequently, the percentage of false negatives and true positives was assessed using a cross-tabulated table to determine the best criterion variable.

Analyses were carried out using SPSS 24.0 for Windows and Microsoft Excel 2010 spreadsheets.

3. Results

Characteristics of studied population

The SPAI-Spain questionnaire was completed by 2598 participants, whose sociodemographic characteristics as well as the profile of use of the smartphone are shown in Table 1.

Table 1. Characteristics of the studied population

	Mean	SD	n	%
Age	27.96	12.13		
18-25			1944	65.7
26-35			408	13.8
36-45			253	8.6
Over 46			353	11.9
Gender				
Men			1025	34.7
Women			1933	65.3

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Age when started using smartphone	17.11	9.27		
Smartphone's dedication hours				
<4 (Non dependent)			2062	69.7
≥4 (Dependent)			896	30.3
Smartphone's dependence perception				
<8 (Non dependent)			2005	67.8
≥8 (Dependent)			953	32.2

ROC analysis' results

The area under the curves is 0.78 [0.763-0.798], using as a criterion variable the perception of dependence and 0.699 [0.679-0.719] with the variable dedication time (in hours) as a criterion variable, as shown in Figure 1 and Figure 2, respectively.

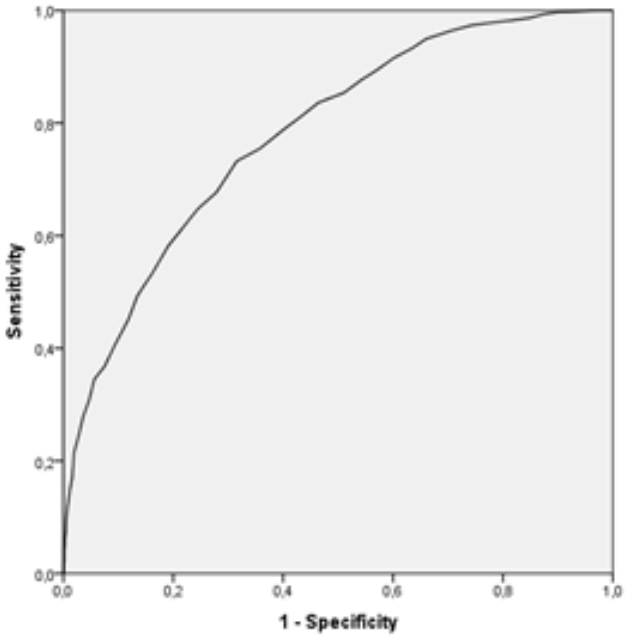

Fig. 1: ROC curve. Criterion variable: self-dependence perception

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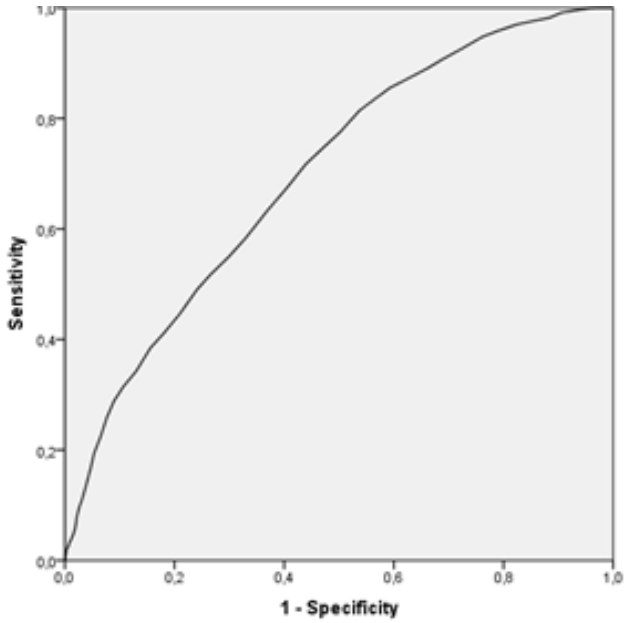

Fig. 2. ROC curve. Criterion variable: hours of dedication

SPAI-Spain cut-off score determination

To identify which could be the best cut-off point, the sensitivity and specificity corresponding to each of the scores of the questionnaire for the variable dependence perception and dedication hours, as well as the Youden Index were calculated. It was established that the cut-off point would be the SPAI-Spain score corresponding to the highest value of the Youden index. In the case of dependence self-perception, it could be stablished at the score 44 (corresponding to a Youden's J of 0.416), while in the case of the variable hours of dedication the cut-off point would be established at the value 42 (which corresponds to a Youden's J value of 0.278). Table 2 shows sensitivity, specificity and Youden's J values for each SPAI-Spain score.

TABLE 2 Sensitivity, specificity and Youden Index of cutoff points in SPAI-SP between diagnostic positive and negative groups.

	Dependence self-perception			**Dedication hours**		
	Sensitivity	Specificity	**J**	Sensitivity	Specificity	**J**
23	1	0	**0**	1	0	**0**
24	1	0.029	**0.029**	1	0.029	**0.029**
25	0.999	0.046	**0.045**	0.999	0.045	**0.044**
26	0.998	0.071	**0.069**	0.996	0.068	**0.064**
27	0.997	0.1	**0.097**	0.991	0.095	**0.086**
28	0.994	0.124	**0.118**	0.982	0.116	**0.098**
29	0.986	0.153	**0.139**	0.977	0.145	**0.122**
30	0.982	0.186	**0.168**	0.97	0.176	**0.146**
31	0.978	0.223	**0.201**	0.959	0.209	**0.168**
32	0.974	0.257	**0.231**	0.948	0.239	**0.187**
33	0.963	0.297	**0.26**	0.927	0.274	**0.201**
34	0.95	0.339	**0.289**	0.906	0.313	**0.219**
35	0.933	0.365	**0.298**	0.891	0.339	**0.230**
36	0.916	0.398	**0.314**	0.874	0.371	**0.245**

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37	0.892	0.433	**0.325**	0.855	0.408	**0.263**
38	0.877	0.457	**0.334**	0.838	0.431	**0.269**
39	0.854	0.489	**0.343**	0.815	0.462	**0.277**
40	0.836	0.536	**0.372**	0.775	0.499	**0.274**
41	0.815	0.563	**0.378**	0.751	0.524	**0.275**
42	0.787	0.601	**0.388**	0.718	0.56	**0.278**
43	0.754	0.643	**0.397**	0.673	0.596	**0.269**
44	0.732	0.684	**0.416**	0.634	0.63	**0.264**
45	0.677	0.721	**0.398**	0.584	0.67	**0.254**
46	0.647	0.755	**0.402**	0.549	0.701	**0.25**
47	0.611	0.785	**0.396**	0.518	0.734	**0.252**
48	0.582	0.809	**0.391**	0.491	0.758	**0.249**
49	0.533	0.838	**0.371**	0.446	0.79	**0.236**
50	0.494	0.865	**0.359**	0.412	0.819	**0.231**
51	0.451	0.882	**0.333**	0.385	0.844	**0.229**
52	0.406	0.906	**0.312**	0.343	0.87	**0.213**
53	0.368	0.925	**0.293**	0.315	0.893	**0.208**
54	0.345	0.944	**0.289**	0.288	0.911	**0.199**
55	0.308	0.953	**0.261**	0.258	0.924	**0.182**
56	0.278	0.964	**0.242**	0.225	0.934	**0.159**
57	0.241	0.973	**0.214**	0.194	0.947	**0.141**
58	0.215	0.981	**0.196**	0.165	0.953	**0.118**
59	0.172	0.984	**0.156**	0.133	0.962	**0.095**
60	0.146	0.989	**0.135**	0.109	0.969	**0.078**
61	0.128	0.991	**0.119**	0.096	0.974	**0.070**
62	0.108	0.994	**0.102**	0.079	0.978	**0.057**
63	0.089	0.995	**0.084**	0.061	0.981	**0.042**
64	0.073	0.996	**0.069**	0.05	0.983	**0.033**
65	0.062	0.997	**0.059**	0.042	0.987	**0.029**
66	0.052	0.997	**0.049**	0.037	0.989	**0.026**
67	0.042	0.998	**0.04**	0.031	0.992	**0.023**
68	0.035	0.998	**0.033**	0.026	0.993	**0.019**
69	0.028	0.998	**0.026**	0.023	0.995	**0.018**
70	0.024	0.998	**0.022**	0.021	0.996	**0.017**
71	0.019	0.999	**0.018**	0.018	0.998	**0.016**
72	0.014	0.999	**0.013**	0.012	0.998	**0.01**
73	0.008	0.999	**0.007**	0.009	0.999	**0.008**
74	0.007	0.999	**0.006**	0.008	0.999	**0.007**
75						
76	0.005	0.999	**0.004**	0.006	0.999	**0.005**
77						
78	0.004	0.999	**0.003**	0.004	0.999	**0.003**
79	0.003	0.999	**0.002**	0.003	0.999	**0.002**

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80	0.003	1.000	**0.003**	0.002	0.999	**0.001**
81	0.002	1.000	**0.002**	0.001	0.999	**0.000**
82	0.001	1.000	**0.001**	0	0.999	**0.000**
83	0.000	1.000	**0.000**	0	1	**0.000**

From these cut-off points identified according to the two established criteria, we decided to analyze what percentage of subjects would be well classified with each of said cut-off points. These results are shown in Table 3.

Table 3. Participant's classification according to their addiction level for each criterion variable's cut-off point.

		SPAI-SP: cutoff point =44			
		Non dependent		Dependent	
		N	%	n	%
Dependence self-perception	Non dependent	1371	68.40	632	31.60
	Dependent	255	26.80	698	73.20
		SPAI-SP: cutoff point =42			
		Non dependent		Dependent	
		N	%	n	%
Hours of dedication	Non dependent	1154	56.00	906	44.00
	Dependent	254	28.20	643	71.80

Although the cut-off point is stricter using the hours of dedication as a criterion variable, the percentage of true positives (dependent-addicts) is greater in the case of variable dependence self-perception of dependence (73.2% versus 71.8%). Likewise, the percentage of false negatives is higher, using as variable self-perception of dependence than using hours of dedication (68.4% versus 56.0%). Subsequently, the score 44 in SPAI-Spain is considered as its cut-off point. It is the one obtained when considering the subjective self-perception of dependence as a criterion, since it allows us to better classify both the non-dependent subjects and the dependent subjects.

4. Discussion

The perceived addiction refers to the propensity of a person to report that he feels deregulated and is compulsive in his use. In this situation, the focus is on the subjective assessment, instead of the measured behaviors objectively, and the focus is on perception, which can be considered as a relevant clinical construct and predict levels of psychological distress [18]. Different studies relate the subjective perception of a phenomenon with it, considering it an indicator of reality and allowing the design of preventive measures, existing examples in different situations such as the dependence on text messages [7], the use / addiction to pornography and personality factors [18], among others. Self-schemas have received more attention as favorable objectives for therapeutic intervention due to the central role they play in influencing self-perception and behavior [17].

For this reason, we understand that the self-perception of dependence on the smartphone, evaluated with the SPAI-Spain scale, can also be a predictor of this addiction. Thus, we have divided subjects into "dependent or not dependent according to their subjective perception, which we have considered a good parameter to establish a cut-off point in the SPAI-Spain instrument that could allow researchers to identify those subjects with smartphone addiction. This self-perception of mobile dependence has also been measured in other researches, such as is this European study in which it was identified that young people in southern Europe (including the Spanish) showed the highest phone usage time, predictor of their dependency levels, measured in this case with the PMPUQ [26].

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In the validation study of the SPAI-Spain version from which this work for the determination of a cut-off point arises, we set out to analyze a series of variables that would serve as comparison criteria with the results of the questionnaire. Among these collected data, we find a subjective criterion, such as the self-perception of mobile addiction and an objective criterion, such as the number of hours an individual uses the mobile phone. For this reason, later, we have tried to use both measures to establish the cut-off point, finding that the subjective perception of dependence is a criterion that allows us to predict addiction better than the time it is used.

The methodology used to establish this cut-off point was based on the determination of the AUC in the ROC curve; Subsequently, the sensitivity (capability to detect addicted individuals) the specificity (capability to detect non-addicted individuals), and the Youden index for each of the cut points have been analyzed, choosing as cut-off that with a higher index of Youden [25,27]. This methodology has been used in other works in which the objective was to establish this cut-off point from which to establish a classification of the population based on the presence or absence of a certain characteristic, evaluated by means of the instrument we are using [27-29].

Thus, considering that the cut-off point based on the self-perception criterion, is the one which allows us to classify the participants in the study more adequately, we have decided to establish the value 44, which was the one with the highest Youden index (and therefore greater sensitivity).

Using this cut-off point, we will classify a percentage of the participants in the study will be classified as dependents to the smartphone. Also, when considering their own perception as a descriptor of this dependency, a percentage of the participants consider themselves as dependent, which shows how self-perception would be a good predictor of the level of dependence measured by the SPAI scale.

It was not possible to compare the cut-off point established in the Spanish version of the SPAI with the versions of the instrument in other languages, since we have only found one work in which it has been proposed to establish this cut-off point, in the short version of the instrument, which consists of only 10 items, instead of the original instrument's 26 [29]. In the other versions of the SPAI, such as the Brazilian, the Turkish or the Italian one, the establishment of said cut-off point was not considered [30-32].

This work is based on the study to validate the Spanish version of the SPAI, which was carried out with a large number of participants, although two thirds of this population are people between 18 and 25 years of age, the age group with a higher percentage of addiction to the smartphone, something that we have also objectified in our results.

The establishment of a cut-off point in the SPAI-Spain instrument, which determines from what score a person is considered as addicted, allows it to be converted into a diagnostic instrument, which will allow identifying subjects with levels of dependence smartphone and the establishment of measures to prevention/management of the problem identified by health professionals. It supposes an implication in the daily practice of health professionals to be able to use an easy, simple and manageable tool in the detection of mobile addiction. At the same time, it allows the screening of the general population in the existence of a disorder such as addiction to mobile phones and thus be able to establish therapeutic interventions. On the other hand, it is essential to assess the feeling of self-perception of people regarding their addiction, which will allow the involvement in these therapeutic interventions.

As other researchers claim problematic mobile use is an evolving public health concern that requires greater study to determine the boundary between helpful and harmful technology use [11]. The determination of a risk score can allow in the future the establishment of mobile dependence prevalence studies, as well as the establishment of early detection programs and adequate treatment of this current public health problem.

5. Conclusions

It has been determined based on the analysis of performed a cut-off value for the SPAI-SP scale in 42 based on the self-perception of addiction.

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The establishment of its cutoff point allows the use of the scale as a diagnostic tool to improve the detection and early treatment of addicted persons.

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