# The Validity and Reliability of the Serbian Version of the Smartphone Addiction Scale – Short Version

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**Research**

**Keywords:** Smartphone Addiction Scale-Short Version (SAS-SV), validity and reliability, Serbian version, Smartphone Addiction Scale, Short Version

**Posted Date:** July 9th, 2021

**DOI:** https://doi.org/10.21203/rs.3.rs-676215/v1

# Abstract

**Background:** In recent years, the need for validated and reliable questionnaires for different applications could be observed throughout scientific literature. To add to this trend, we translated into Serbian the Smartphone Addiction Scale-Short Version (SAS-SV) and tested it for its psychometric properties. This study's main aims were to test the Serbian version of the SAS-SV's internal consistency and reliability and estimate smartphone addiction prevalence among medical students.

**Methods:** The study was conducted in December 2018 on a representative sample of third-year medical students. The cross-cultural adaptation was performed following the well-established guidelines for cross-cultural adaptation of self-reported measures. For test-retest reliability, students filled the questionnaire twice, within seven days.

**Results:** The Serbian version of SAS-SV showed good internal consistency (Cronbach's alpha = 0.89) and excellent reliability for test-retest scores (ICC = 0.94, 95% CI = 0.92-0.96). Factor analysis supported the extraction of one factor, which explained 51,5% of the variance. To explore construct validity furthermore, SAS-SV was correlated with time indicators of smartphone use. According to cut-off values for the SAS-SV score, 19.5% of students could be regarded as “addicted” and often spent more time on **smartphones and social networks on working days and weekends than “not addicted” students.**

**Conclusion:** The SAS-SV in the Serbian version is a reliable and valid instrument for detecting smartphone addiction among university students. Further research on this issue is encouraged to enable a better understanding of this ever-increasing public health issue.


# Introduction

There are more than three billion smartphone users worldwide, and the number is forecasted to grow by several hundred million in the next few years. China, India, and the United States are the countries with the highest number of smartphone users (these countries alone account for 1.46 billion users) [1]. The latest generations of smartphones have some of the functions of a computer, such as a touch screen, the access to the Internet, and the operating system that can run different applications [2]. They cover a wide range of online activities, such as surfing the Net, e-mail, video games, gambling, the access to social networks (e.g. Instagram, Facebook, Twitter, …). Due to their multifunctionality and accessibility smartphones have become necessary across many life domains and in many professions. Smartphones have become a substitute for computer for some people. For others, they became the most convenient way to entertain themselves anytime and anywhere. Their use have changed the way of communication and information, and also led to concerns about their excessive use and dependence.

Despite the apparent advantages of using smartphones, a growing literature finds many people overuse their phones in ways that interfere with their daily activities [3, 4]. Problematic usage of smartphones is associated with different types of psychopathology, including anxiety and depression [5, 6], and poorer sleep quality [5]. The rising use of smartphones and the fact that they provide many features have

brought possible smartphone addiction into the focus of research [7]. On one hand, smartphone addiction could be considered a form of technological addiction [8]. These addictions could be regareded as a subset of behavioral addictions since behavioral addictions feature addiction's core components (such as salience, mood modification, tolerance, withdrawal symptoms, conflicts between the addict and those around them, relapse) [9]. There are no official diagnostic criteria for smartphone addiction in literature, but it is evident that it is related to all three essential aspects of health: physical, social, and mental.

On the other hand, smartphone addiction characteristics are similar in many aspects to internet addiction [7]. Based on the definition of Internet addiction, smartphone addiction is defined as the excessive use of smartphones that interferes with users' daily lives [5, 7, 8]. Smartphone addiction is a new behavior addiction, and more research is still needed to define all its aspects thoroughly. There are several scales developed to identify potential smartphone addicts [7, 10, 11]. The most frequently used tool to assess smartphone addiction is the Smartphone Addiction Scale - Short - Version (SAS-SV) developed in South Korea [12]. It is short and easy to complete and was validated in several languages so far [13–17]. However, there are no empirically validated assessment tools for smartphone addiction available in Serbia.

The primary objectives of this study were to:

1. Translate, and linguistically and curturally adapt Smartphone Addiction Scale – Short Version into Serbian;
2. test indicators of the reliability and validity of the Serbian version of the SAS – SV;
3. describe smartphone usage in terms of time spent and estimate the prevalence of smartphone addiction among medical students.

## Material And Methods

# Translation process

After getting permission from the institutional ethics committee (Faculty of Medicine, University of Belgrade) (No. 2650/XII-1) and the author of the original scale, the translation process was conducted following well established principles [18]. Primarily the SAS-SV was forward translated into Serbian by two indipendent translators (Serbs fluent in English). Group of four experts in specific medical field discussed and recoinciled two translated versions and the consensus was made for the first Serbian version of the questionnaire. After that, native English speaker who had not previously seen the original, had back-translated the first Serbian version of the questionnaire in English. The two translations obtained were compared to the original English version by a group of experts who discussed the differencies and resolved any inconsistencies. Terms and expressions that are common in everyday Serbian language were used. The final result was the second Serbian version of SAS-SV questionnaire (see Additional file 1).

# Participants and data

The study was conducted in December 2018. Participants were students in the third year of studies at the Faculty of Medicine, University of Belgrade. The sample size was calculated using Epi Info 7 (version 7.2.4.0) (population size 523 third-year medical students, expected frequency 29.8% [19], an acceptable margin of error 5%, design effect 1) to be 199. Since there were 4 groups of 21–27 students that attend epidemiology class each day, we randomly chose 3 groups each day (15 groups) to fill the questionnaire. A total number of 323 third-year students completed the questionnaires. Of all students that filled questionnaire three groups (77 students) were randomly chosen to complete the questionnaire second time within seven days in order to test the test-retest reliability of the Serbian version of SAS-SV.

Students were offered to voluntarily fill the questionnaire at the beginning of their Epidemiology classes. They were informed about the aims of the study, and signed an informed consent.

# Measures

Smartphone Addiction Scale - Short Version (SAS-SV) is a self-reported scale with 10 items rated on a 6-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = weakly disagree, 4 = weakly agree, 5 = agree, 6 = strongly agree) [12]. The total score ranges from 10 to 60. The higher scores on the scale indicate a higher level of smartphone addiction. The questionnaire includes ten questions addressing daily-life disturbance, withdrawal, cyberspace-oriented relationships, overuse, and tolerance. Males are considered addicted with scores higher than 31 (sensitivity value of 0.867 and specificity value of 0.893) and females with scores higher than 33 (sensitivity value of 0.875, and a specificity value of 0.886) [12]. The items were selected from the original Smartphone Addiction Scale (SAS), consisting of 33 items [7], based on their validity. The correlation between SAS-SV and SAS is 0.96 [12].

Beside this, specifically developed questionnaire was used to gather sociodemographic characteristics of participants (gender, age, residence, housing, socio-economic status, grade point average (GPA)), and mobile phone usage patterns (see Additional file). Smartphone usage patterns consisted of questions where students had to write how many hours daily they spent using smartphones and social networks on working days and weekends.

# Statistical analysis

For main standard statistical procedures (e.g. t-tests, Chi-square test, Mann-Whitney U test, Explanatory Factor Analysis) SPSS 21.0 (SPSS Inc., Chicago, IL, USA) was used with the difference marked as significant at $p < 0.5$ [20]. To asses inter-item correlations, a conventional index of consistency, Cronbach's alpha, was used. Assesment was also made by excluding one item each time to check the contribution of that item to the scale's homogeneity. The intraclass correlation coefficient (ICC) and its 95% confidence interval (95% CI) were used to asses test-retest reliability. Reliability was considered satisfactory if ICC > 0.7 [19]. Exploratory Factor Analysis was used to examine the questionnaire's internal structure since it was the first time exploring the factor solution in Serbian adaptation. The Kaiser Meyer-Olkin Measure and Bartlett's Test of Sphericity were computed to determine whether the data were suitable for factor analysis [20]. A factor analysis was used to obtain independent factors and an item was considered to be loaded on a factor if the matrix coefficient was 0.40 or larger. The normality of data distribution was

assessed visually and supplementd by Kolmogorov-Smirnov test. Spearman correlations (when data were not of normal distribution) between the SAS-SV score and time indicators (time spent on mobile phones during working days and weekdays, time spent on social media on mobile phones during working days and weekdays) were also calculated. The Spearman correlation values (ρ) represented: $\rho < 0.10$ small effect, $\rho < 0.30$ medium effect, and $\rho = 0.50$ large effect [20]. To assess smartphone addiction prevalence among students, we used cut-off values recommended by the original questionnaire's authors [12]], see above.

## Results

# Sample characteristics

Participants were 323 students in the third year of studies at the Faculty of Medicine, University of Belgrade, of which 100 (31.0%) were males and 223 (69.0%) females. The mean age of participants was 21.0, with a standard deviation of 0.55. Almost every second Student was from Belgrade (49.2%), while the rest were from the other regions (Central Serbia, Vojvodina, and other countries' parts). A 41.2% of students lived with their parents. Other students (58.8%) lived in their flat, students' dorm, rented flat/room, or stayed with friends/cousins. Almost two-thirds of students claimed to have good socio-economic status (61.3%). The average GPA (grade point range from 6 to 10) was 8.80 (SD 0.72).

# Internal consistency and test re-test reliability od SAS-SV questionnaire

Results of item analysis of Serbian version of SAS-SV are shown in Table 1. The internal consistency was assessed by Cronbach's alpha coefficient and it showed almost excellent level of internal consistency (Cronbach’s alpha = 0.89). The test-retest reliability of the SAS-SV was examined on 77 students to determine whether the scores derived were relatively stable over time, which was short enough that little real change could be expected. ICC and its 95% CI were calculated as a level of agreement between the initial and seven-day follow-up scores. The test-retest reliability of the SAS-SV questionnaire was excellent (ICC = 0.94, 95% CI = 0.92–0.96, $p < 0.001$).

Table 1
Items and reliability of the Serbian version of the short version of the Smartphone Addiction Scale – Short Version (SAS-SV) (n = 323 students)

| Original statement | $\bar{X}$ | SD | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| Missing planned work due to smartphone use | 2.56 | 1.53 | 0.69 | 0.88 |
| Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use | 2.22 | 1.35 | 0.65 | 0.88 |
| Feeling pain in the wrists or at the back of the neck while using a smartphone | 1.70 | 1.13 | 0.52 | 0.89 |
| Won't be able to stand not having a smartphone | 2.55 | 1.68 | 0.65 | 0.88 |
| Feeling impatient and fretful when I am not holding my smartphone | 2.26 | 1.44 | 0.70 | 0.88 |
| Having my smartphone in my mind even when I am not using it | 1.84 | 1.20 | 0.73 | 0.88 |
| I will never give up using my smartphone even when my daily life is already greatly affected by it | 2.35 | 1.44 | 0.59 | 0.88 |
| Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook | 2.21 | 1.38 | 0.59 | 0.88 |
| Using my smartphone longer than I had intended | 3.57 | 1.65 | 0.64 | 0.88 |
| The people around me tell me that I use my smartphone too much | 2.26 | 1.43 | 0.64 | 0.88 |
| $\bar{X}$-mean; SD-Standard Deviation | | | | |

Exploratory Factor Analysis was used to examine further inter-item relationships and dimensions of the questionnaire. Factor extraction was performed by principal component analysis with Varimax rotation (Table 2). Calculated Kaiser-Meyer-Olkin Measure of Sampling Adequacy 0.89 and highly significant ($p < 0.001$) Bartlett's Sphericity Test ($\chi^2 = 1565.45$) indicated that factor analysis was appropriate. All 10 questions showed suffiecient loadings on the firsit principal component to be retained (minimally loading item was question 3 and 8: 0.448 and 0.451). According to factor analysis, two factors had eigenvalues greater than one (initial eigenvalues 5.154 and 1.085). Together, these two factors explained 62.391% of the total variance (the first factor explains 51.538%, while the other explains 10.853% of the variance).

Table 2
Principal Component Analysis of SAS-SV (n = 323 students)

| | Rotated Component Matrix[a] | | Component Matrix[b] |
|---|---|---|---|
| Question | Component | | Component |
| | 1 | 2 | 1 |
| Q1 | 0.181 | 0.878 | 0.748 |
| Q2 | 0.201 | 0.826 | 0.727 |
| Q3 | 0.228 | 0.630 | 0.606 |
| Q4 | 0.834 | 0.196 | 0.728 |
| Q5 | 0.802 | 0.291 | 0.773 |
| Q6 | 0.651 | 0.487 | 0.805 |
| Q7 | 0.768 | 0.171 | 0.665 |
| Q8 | 0.535 | 0.406 | 0.666 |
| Q9 | 0.403 | 0.609 | 0.716 |
| Q10 | 0.440 | 0.585 | 0.725 |
| Extraction Method: Principal Component Analysis. | | | |
| [a] Rotation Method: Varimax with Kaiser Normalization. | | | |
| [b] 1 components extracted | | | |

# Correlation between the total SAS-SV score and time spent on smartphones

The mean time spent on smartphones on working days was 3.83 ± 3.16 hours and 4.53 ± 3.48 hours on weekends (Table 3). The mean time spent on social media on working days was 2.69 ± 2.70 hours and 3.29 ± 3.04 hours on weekends. SAS-SV scale significantly correlated with mean time spent on smartphones on working days ($r = 0.31$, $p < 0.001$), weekends ($r = 0.32$, $p < 0.001$), as well as social media usage on working days ($r = 0.39$, $p < 0.001$), and weekends ($r = 0.42$, $p < 0.001$). Associations between time indicators of smartphone use and SAS-SV total score strengthen the validity of our adaptation.

Table 3
Correlation between the SAS-SV score and time spent on smartphones (n = 323 students)

| Average time spent on smartphone | Hours X̄±SD | ρ* | p |
|---|---|---|---|
| Smartphone usage on working days | 3.83 ± 3.16 | 0.31 | < 0.001 |
| Smartphone usage on weekends | 4.53 ± 3.48 | 0.32 | < 0.001 |
| Social networks (working days) | 2.69 ± 2.70 | 0.39 | < 0.001 |
| Social networks (weekends) | 3.19 ± 2.98 | 0.42 | < 0.001 |

X̄-mean; SD-Standard Deviation; *Spearman correlation coefficient; p value for Spearman correlation

In our sample, the mean SAS-SV score was 23.51 ± 10.22 (minimum 10, maximum 56). Students classified as "addicted" had significantly higher SAS-SV scores (39.57 ± 6.32) than “not addicted” students (19.62 ± 6.51) (p < 0.001). According to cut-off values for the SAS-SV score, 63 students (19.5%) could be regarded as “addicted”. Females (22.0%) showed higher percent of potential addiction than males (14.0%), but without statistical significance (p = 0.095).

"Addicted" students often spent more than 3 hours a day on smartphones and social networks on working days and weekends than not addicted students (Table 4).

Table 4
Time spent on smartphones and social networks among “not addicted” and “addicted” students of Medicine (n = 323 students)

| Time spent on smartphone | Smartphone addiction status | | p value* |
|---|---|---|---|
| | “Not addicted” (n = 242) No (%) | “Addicted” (n = 62) No (%) | |
| Smartphone usage > 3h (working days) | 86 (33.6) | 40 (63.5) | < 0.001 |
| Smartphone usage > 3h (weekends) | 102 (39.8) | 48 (76.2) | < 0.001 |
| Social networks > 3h (working days) | 36 (15.2) | 28 (46.7) | < 0.001 |
| Social networks > 3h (weekends) | 52 (21.7) | 38 (61.3) | < 0.001 |

# Discussion

The Smartphone Addiction Scale – Sort Version in the Serbian language showed good internal consistency, and excellent test-retest reliability in our sample. Reliability measures achieved were

excellent (Cronbach alpha 0.89, similar to those obtained by previous studies using the SAS-SV (the original SAS-SV South Korea 0.91, [12]; Turkey 0.88 [15], Spain 0.88 [16], Belgium 0.90 (adaptation in French) [16] and Switzerland 0.85 (adaptation in German) [21]). The corrected item-total correlations ranged from 0.53 to 0.73, similar to comparable studies using the SAS-SV (0.50 to 0.80 in the original study by Kwon et al., 2013 [12]; 0.43 to 0.76 in the Turkish version [15]; 0.42 to 0.76 in Arabic version [17]; 0.46 to 0.71 in Spain [16] and from 0.62 to 0.74 in Belgium (French version) [16]. The results related to test-retest evaluation demonstrated good reliability of the responses (ICC = 0.94). The final model approach to deciding to extract only one factor in our factor analysis was based not only on conventional rule to extract all factors with *eigenvalue* greater than 1, but we also took into condsideration other issues. Mainly, steepness of the curve on scree plot (sharp decline) was arguing against extraction of second factor (first 5.154, and second 1.085), and for eigenvalues from 0.90 and 1.30 there are other rules that should be considered (e.g., interpretabilty of factor solution). We attepted the extraction of second factor, which lead to split in 5 questions on each factor, but due to severe cross-loading of all 5 questions (items 1, 2, 4, 5 and 7 in second factor) we found this factor uninterpretable. Other authors extracted one factor as well, and our result is in accordance with their data [15, 17, 22].

The participants evaluated in the present study spent about 4 hours daily on a smartphone during working days, and even more on weekends. That represents almost 17% of the day spent using the device, which is alarming for this population. The variables related to time indicators were significantly and positively correlated with higher SAS-SV scores; however, the correlation was considered of medium strength. Similar results were shown in the Brazilian study [13] and in the study by Lopez Fernandez O. et al. [16], where all time variables were significantly positively correlated with higher SAS-SV scores in Spain and Belgium. In addition, in our study, "addicted" students spent significantly more time on smartphones than the “not-addicted” ones. Regarding the rating scale, we found a high potential prevalence of smartphone addiction (19.5%). The SAS-SV was also used to determine the prevalence of smartphone addiction among students in other countries such as Switzerland (16.9%) [21], China (29.8%) [19], Brazil (33.1%) [13], Saudi Arabia (71.9%) [23]. Lopez-Fernandez [16] found the prevalence of excessive smartphone use of 12.5% in Spanish and 21.5% in Belgian students and university staff. Among Chinese adults, the prevalence assessed using the same instrument was 38.5% [22], while in Morocco, it was 55.8% [17]. Therefore, an increasing trend in the use of smartphones can be noticed.

The present study has several limitations. The cut-off scores used for the Serbian version of SAS-SV were based on the original scale. Although recommended cut-off values were widely used by researchers in different study populations (from children to adults), it is highly recommended to assess the predictive validity of this scale and report adequate cut-off scores in males and females. Indicators of smartphone use were assessed through self-reporting, not objectively recorded data. It is recommended that future studies include objectively recorded data on the use of the smartphone (e.g., acquired via a smartphone application) since the use of self-report questionnaires could lead to underestimation or overestimation of participants' use of a smartphone. However, the SAS-SV is among the most widely used and translated instruments to assess smartphone addiction. Widespread use of SAS-SV could provide a unified approach to data collection, as well as its comparability.

# Conclusion

The SAS-SV in the Serbian version is a reliable and valid instrument for detecting potential smartphone addiction. The prolonged use of the smartphone may negatively affect different mental and physical health indicators. Several hours spent on a smartphone and a prevalence of addiction of 19.5% among medical students suggest that there is a need for further research on excessive smartphone usage and its drivers and consequences so that adequate preventive measures could be implemented.

# List Of Abbreviations

SAS - Smartphone Addiction Scale

SAS-SV - Smartphone Addiction Scale - Short – Version

GPA - Grade Point Average

ICC - Intraclass Correlation Coefficient

# Declarations

**Acknowledgments.**

We thank Jovan Grujicic (student at Biochemistry, Ave Maria University, FL 34142, USA) for entering the data from the questionnaire into the SPSS database for this manuscript.

**Funding.**

This paper was funded by Ministry of Education, Science and Technological Development of the Republic of Serbia [project No. 175042; 2011-2019].

**Conflicts of interest/Competing interests.**

The authors have no conflict of interest to declare.

**Availability of data and material.**

The dataset(s) supporting the conclusions of this article is(are) included within the article (and its additional file(s)).

**Code availability.**

Not applicable.

**Authors' contributions.**

SSG and AN were initiators and did initial design of the study; AN, MV, SM, NL, DN and IK all helped with data collection; AN and SSG have performed necessary data analysis and its interpretation; IS and BB advised on statistical analysis; AN and SSG were involved in drafting of the article; and SSG revised the manuscript for important intellectual content.

**Ethics approval.**

Ethics Committee, Faculty of Medicine, University of Belgrade (No. 2650/XII-1).

**Consent to participate/Consent to publish.**

Informed consent was obtained from all individual participants included in the study.

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