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ORIGINAL ARTICLE

Factors associated with the academic use of smartphones in medical students. Based on 40 universities in Latin America

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ABSTRACT

Objective: to identify the factors associated with the academic use of smartphones in medical students from 40 faculties in Latin America.

Material and Methods: A cross-sectional study was conducted in medical students from 40 faculties in Latin America. A questionnaire was used to measure the academic use of Smartphone, and its association with socio-academic variables, training in scientific databases and appreciation of technologies provided by the university. Multilevel random effects models were used to estimate prevalence ratios. The contribution of each co-variable was evaluated using nested models using the log-likelihood ratio test.

Results: We surveyed 11587 participants. 40.9% belonged to academic groups. 68.2% reported using a Smartphone for academic purposes. A positive association was found between academic use of Smartphone and female sex (PR: 1.16, 95% CI: 1.06-1.26, p = 0.001), from Paraguay (PR: 1.44, 95% CI: 1.33-1.55, p < 0.001), carry out clinical cycles (PR: 1.12, IC95%: 1.03-1.23, p = 0.012), training in SCOPUS (PR: 1.26, IC95%: 1.17-1.35, p <0.001) and belonging to research groups (PR : 1.23, 95% CI: 1.13-1.34, p <0.001). In multiple regression, students affiliated with academic groups had 18% less prevalence of Smartphone academic use (PR: 0.82, 95% CI: 0.75-0.89, p <0.001).

Discussion: Most students used Smartphone for academic purposes. The affiliation to academic groups seems to reduce the prevalence of its use. More evidence is needed on the factors related to the use of information technologies such as the Smartphone, particularly in the student-physician population.

Keywords: Smartphone, information and communication technologies, medical student, medical education.

INTRODUCTION

According to a study conducted by the European Union, 8 out of 10 Internet users have surfed using Smartphone (1). The word smart is related to electronic devices today, including televisions, watches, and telephones, the latter being an essential element of our daily life, which has transformed communication(1–3). The use of smartphone allows receiving and sending emails, carrying out academic activities and having better access to Internet information (4). Reports indicate 8 out of 10 doctors and medical students use Smartphone (5). Therefore, the medical field is no stranger to these changes; it is known that medical students require learning tools such as the smartphone that complements the teaching method (6).

Previous studies on the use of information and communication technologies (ICT) have demonstrated their practical educational use (7–10). In the case of smartphone, it has also detailed the multiple benefits in daily learning for quick access to reliable information, social connectivity with other students, tutors, videoconferences, storage of learning information (6) and applicability in medical care with the use of mobile applications for diagnosis and treatment of diseases (11,12).. Despite this, there is no conclusive evidence in the literature about the factors related to the use of this mobile device in medical students, particularly if belonging to a group of studies or research as well as training in scientific data influence negative or positive in the educational use of smartphone.

The objective of this study was to identify the factors associated with the academic use of smartphones, using data from self-administered surveys in students from 40 medical schools from 11 Latin American countries.

MATERIALS AND METHODS

Study design: A cross-sectional study of secondary data analysis was conducted in medical students from 40 faculties in Latin America, 2016, which aimed to identify the factors associated with the academic use of Smartphone.

Population and Sample: Medical students from 40 faculties in Latin America during the academic semester 2016-I. The original study included those students who provided verbal consent to participate in the research and were in the 2016-I academic year. Students who were in Medical Internship were excluded. The present study included all the participants in the original study. The sampling of the research was randomized stratified by academic year.

Study Procedures: The primary research protocol was designed and presented at an international medical-student scientific event in Panama, 2015. Delegates from 69 scientific societies (SOCEM, acronym in Spanish) that are regular and regular members of the Latin American Federation of Scientific Societies of Medical Students were invited (FELSOCEM, acronym in Spanish). From the total of SOCEM, the commitment of 40 SOCEMs from 11 countries in Latin America was finally obtained, who carried out the research.

A collaborative research team was formed in each participating site, who self-administered the questionnaire at the beginning or end of an academic class, previously requesting permission from the medical school and teaching staff in charge of that class. The research team of each site requested verbal consent from the potential participants and then randomly selected the students within the classroom until obtaining the total number of respondents necessary according to the sample size calculated for that year of studies. The average execution time of the instrument was 15 minutes.

Through virtual work meetings, each collaboration of the headquarters was trained in aspects related to the management and handling of data obtained, designing a homogenous data entry sheet for all study sites. Also, a schedule of activities for efficient conduction of the investigation was structured. Pre-typing quality control process was carried out and subsequent data entry in the Microsoft Excel program, in charge of the collaboration team of each headquarters.

Instrument and variables: The questionnaire was constructed based on an instrument validated in the form and substance of a similar study that evaluated the use of information and communication technologies (ICT) in four Peruvian cities (10). It was composed of nine sections: socio-academic questions, knowledge, and use of ICT, knowledge and use of databases, physio-ergonomic problems secondary to the use of ICT, use of social networks, curricular and extracurricular scientific experience, basic research training, resources technologies present in the university of origin and other questions.

Data was collected from eight types of technology, the smartphone being of greater relevance for the present investigation. The dependent variable, academic use of the smartphone, defined as the self-report of the question about its academic use during smartphone classes, with non-answer options and yes. The independent variables were age, sex, type of university, clinical courses, country of origin, affiliation to SOCEM, group of studies, research group, training for the use of PubMed, SCOPUS, SciELO, and appreciation of technologies provided by the university concerning if they were sufficient and modern.

Statistical Analysis: For the descriptive analysis of numerical variables, the assumption of normality was evaluated graphically and analytically, according to which the measure of central tendency and dispersion was reported. In the case of categorical variables, frequencies and percentages were reported.

For the bivariate analysis of categorical variables, the assumption of expected values was evaluated, using the chi-square independence test. For numerical variables, the assumption of variance homogeneity and normal distribution in each interest group was evaluated, using the Student's t-test. P values less than 0.05 were reported as statistically significant.

In the simple and multiple regression analysis, prevalence ratios (PR) were estimated using multilevel mixed-effects generalized linear model (MEGLM), Poisson family and log link function, robust variance, cluster by the university and 95% confidence intervals. A nested model was constructed, using the log likelihood ratio test (LRTest), according to which the inclusion of each variable was decided. Adjusted models were constructed for each variable that did not enter the parsimony model. The statistical analysis was performed in the STATA v.15.0 program (StataCorp LP, College Station, TX, USA)

Ethical considerations: The original study was approved by the local ethics committee of the Hospital Madre-Niño San Bartolomé, endorsed by the National Institute of Health of Peru. For the present investigation, it was not considered necessary to obtain committee approval as it is an analysis of secondary data. The questionnaires were anonymous, and the confidentiality of the respondents was preserved at all times, using assigned codes.

RESULTS

Of 11587 participants, it was found that the majority was female (53.7%) and the median age was 21 years. 42.8% came from Peru, 52.8% studied at the national university, 56.3% were in clinical cycles, and only 12.5% were affiliated to a SOCEM. The self-reported database as the largest training for use was PubMed (27.3%). More than half of the respondents mentioned that the ICT loan at their university was modern (78.0%) and sufficient (52.1%). 68.2% self-reported smartphone academic use. Table 01.

Table 02 shows the results of the bivariate analysis. The variables that were associated with a higher frequency of academic use of Smartphone (differences greater than 10%) were training for PubMed use ($p < 0.001$), training for use of SciELO ($p < 0.001$) and the appreciation that the loan of ICT was sufficient in their universities ($p < 0.001$). While the variables associated with a lower frequency of our outcome of interest (differences greater than 10%) were training for the use of SCOPUS ($p < .001$) and the appreciation that the ICTs provided by their university were modern ($p < 0.001$).

Table 03 shows the results of the simple, multiple regression analysis (model A) and models adjusted by model A. In the simple regression analysis, the female sex (PR: 1.16, IC95%: 1.06-1.26, $p < 0.001$), being in clinical cycles (PR: 1.12, IC95%: 1.03-1.23, $p = 0.012$), belonging to research groups (PR: 1.23, IC95%: 1.13-1.34, $p < 0.001$), training for use of SCOPUS (PR: 1.26, IC95%: 1.17-1.35, $p < 0.001$) and coming from five (Paraguay, Mexico, Honduras, Colombia and Argentina) of the 11 participating countries were positively associated for the self-report of academic use of smartphone In the multiple regression analysis, the contribution of the co-variables was evaluated through the construction of the nested model, resulting that the students affiliated to academic groups had 18% less prevalence of self-reported smartphone academic use (PR: 0.82, 95% CI: 0.75-0.89, $p < 0.001$). Finally, in the B-M

models, estimates are shown that resulted from adjusting each co-variable that did not enter the parsimony model A.

Table 1: Socio-educational characteristics of medical students from 40 medical schools in Latin America.

Characteristics	N (%)
Gender	
Male	5363 (46.3)
Female	6224 (53.7)
Age (years)*†	21 (15-44)
Country	
Ecuador	638 (5.5)
Panama	634 (5.5)
Paraguay	1073 (9.3)
Bolivia	960 (8.3)
Peru	4962 (42.8)
México	636 (5.5)
Venezuela	643 (5.6)
Honduras	318 (2.7)
Colombia	849 (7.3)
Chile	238 (2.1)
Argentina	636 (5.5)
Type of university	
National	6119 (52.8)
Private	5468 (47.2)
Clinical Courses†	
No	5061 (43.7)
Yes	6525 (56.3)
Belongs to SOCEM	
No	10138 (87.5)
Yes	1449 (12.5)
Belongs to research groups	
No	11147 (96.2)
Yes	440 (3.8)
Belongs to academic groups	
No	6846 (59.1)
Yes	4741 (40.9)
Training in PubMed†	
Do not know	4529 (40.1)
Not trained	3686 (32.6)
Trained	3082 (27.3)
Training in SciELO†	
Do not know	4918 (43.9)
Not trained	4165 (37.2)
Trained	2117 (18.9)
Training in SCOPUS†	
Do not know	9334 (83.8)
Not trained	896 (8.0)
Trained	909 (8.2)
Lend modern ICT†	
No	198 (22.0)
Yes	703 (78.0)
Lend enough ICT†	
No	428 (47.9)
Si	466 (52.1)
Academic use of smartphone	
No	2925 (31.8)
Si	6282 (68.2)

* Mean ± standard deviation
† Some values do not add up to 11587 due to missing data
SOCEM: Scientific Society of Medical Students
ICT: Information and Communication Technologies

Table 2: Factors associated with the academic use of smartphones in bivariate analysis.

Variables	Academic use of smartphones		*p***
	No (n=2925)	Yes (n=6282)	
	n(%)	n(%)	
Gender			<0.001
Male	1504 (35.0)	2799 (65.1)	
Female	1421 (29.0)	3483 (71.0)	
Age (years)*†	21.0 ± 2.8	21.1 ± 2.8	0.08††
Country			<0.001
Ecuador	141 (27.7)	368 (72.3)	
Panama	142 (23.7)	457 (76.3)	
Paraguay	359 (35.6)	650 (64.4)	
Bolivia	349 (45.8)	413 (54.2)	
Peru	1172 (32.0)	2487 (68.0)	
México	105 (19.0)	449 (81.1)	
Venezuela	216 (44.3)	272 (55.7)	
Honduras	112 (39.3)	173 (60.7)	
Colombia	74 (12.7)	507 (87.3)	
Chile	45 (20.7)	172 (79.3)	
Argentina	210 (38.6)	334 (61.4)	
Type of university			<0.001
National	1371 (29.8)	3235 (70.2)	
Private	1554 (33.8)	3047 (66.2)	
Clinical Courses†			0.704
No	1276 (32.0)	2714 (68.0)	
Yes	1649 (31.6)	3568 (68.4)	
Belongs to SOCEM			<0.001
No	2595 (32.6)	5365 (67.4)	
Yes	330 (26.5)	917 (73.5)	
Belongs to research groups			0.723
No	2809 (31.8)	6023 (68.2)	
Yes	116 (30.9)	259 (69.1)	
Belongs to academic groups			0.450
No	1677 (32.1)	3549 (67.9)	
Yes	1248 (31.4)	2733 (68.7)	
Training in PubMed†			<0.001
Do not know	1358 (37.9)	2226 (62.1)	
Not trained	1019 (34.5)	1935 (65.5)	
Trained	493 (19.7)	2007 (80.3)	
Training in SciELO†			<0.001
Do not know	1321 (33.4)	2638 (66.6)	
Not trained	1175 (36.0)	2090 (64.0)	
Trained	363 (20.9)	1371 (79.1)	
Training in SCOPUS†			<0.001
Do not know	2302 (31.0)	5137 (69.1)	
Not trained	257 (32.8)	526 (67.2)	
Trained	288 (42.2)	394 (57.8)	
Lend modern ICT†			0.001
No	6 (7.6)	73 (92.4)	
Yes	130 (23.9)	414 (76.1)	
Lend enough ICT†			<0.001
No	91 (27.1)	245 (72.9)	
Yes	44 (15.4)	241 (84.6)	

* Mean ± standard deviation
† Some values do not add up to 11587 due to missing data
SOCEM: Scientific Society of Medical Students
** Values p calculated with the Chi Square test of independence
†† Value p calculated with the Student's t test

DISCUSSION

In our study, we found that medical students affiliated with an academic group had 18% less prevalence of using smartphones for educational purposes. This could be explained by the fact that this group of students thinks that the use of Smartphone can be a distracting factor in their reading spaces, discussion of group work, among others. Prieto-Miranda et al. had already described that the use of this ICT could lead to distraction during class hours, despite its benefits for recording classes, searching for information on the Internet, storage of academics classes, etc. (13). No studies have been found that have specifically evaluated our exposure of interest to belong to academic groups. However, it is close to that reported by Mejia et al. in Peruvian students, where a negative association was found between the number of hours of use of the Smartphone and the perception in the improvement of academic performance (14). In the United States, one study mentions that the use of cell phones had a negative

impact on academic work (15). Therefore, it corroborates the probable mechanism of negative perception towards the use of Smartphone of the student members of study groups. This decision would be based on their knowledge reported in the literature, which has described disadvantages in medical education, where even problems of addiction have been observed (16,17). Another explanation could be because the students who form groups of studies consider that the use of this type of cell phone could decrease the time with the patients, which has already been described in another study where the frequency was of 37.2% (18). Finally, it is essential to mention the economic factor, previously related in a similar study (19), that causes less use of smartphones for educational tasks, which could mean a barrier for students of academic groups who probably prefer to use texts in physical or digital through the laptop, an ICT of diversified use in university. Despite this, this negative relationship should be corroborated in future similar studies, because there is also literature that affirms the potential benefit of Smartphone use in the educational area, particularly in undergraduate (20–25).

Regarding the frequency of academic use of Smartphone, it turned out that more than half of the Latin medicine students used it (68.2%). This finding is superior to a Peruvian study in which it was found that 39.9% used academic applications on their Smartphone (14). A study in the United Kingdom states that only 37% of respondents reported using this device for the benefit of their medical learning (19). Another investigation in students and doctors found frequent use of Smartphone, reflected in possession of up to more than ten medical applications (26). The educational benefits of this type of mobile device have already been widely described in multiple studies, especially in doctors in training and also specialists. The possession of Smartphone allows access to useful medical applications, either in clinical courses during the hospital stay at the time of identifying the diagnosis of the pathology that a patient suffers or in any case in the therapeutic plan necessary for the recovery of your health (21,24,27). A recent investigation carried out in medical students who were in a research course focused on primary health care, reported that the use of Smartphones improves the management and data management processes as well as the quality of these (28).

Although belonging to academic groups was the only characteristic that explained our outcome of interest, in the simple regression we observed findings that are relevant to discuss briefly. Students trained in the use of SCOPUS were positively associated with the educational use of Smartphone. Training in scientific database training mostly results not only in acquiring and consolidating scientific-academic skills (29,30) but also in the efficient use of ICT for medical training. Also, the affiliation to scientific groups increased the prevalence of educational use of smartphone by 23%. This could be due to the learning message disseminated massively in the SOCEM related to the advantages of using this type of mobile devices, which is done during multiple extracurricular training sessions either face-to-face or virtual (31). Several studies have confirmed the importance of SOCEM within medical schools to cover knowledge not taught in the undergraduate program (32,33). This has enabled training in vital scientific and academic areas, such as scientific writing, scientific databases, biostatistics, which has been reflected in student scientific productivity in indexed scientific journals (34–36).

Our study has limitations related to selection bias since the participating medical schools were eligible according to the criterion of being affiliated with FELSOCEM; therefore it is not possible to extrapolate the results of this study to the entire medical student population. Also, there is information bias because the student's self-report measured the academic use of Smartphone in the questionnaire. It was also not possible to evaluate the mobile applications that the student accessed while using his Smartphone. Finally, due to the design of the study, we can not assure with certainty the temporality in the relation found between the belonging to groups of studies and the academic use of smartphone. However, the strengths of our study lie in the large sample obtained in 11 Latin American countries and the rigorous methodology proposed to estimate the main results, which allows us to provide useful evidence for making decisions that improve medical education in medical schools of Latin America, particularly in identifying the socio-educational factors that contribute to a greater or lesser academic use of Smartphone. This will serve as a basis to conduct studies more ambitions that corroborate not only the hypothesis of interest in the medical student population.

We conclude that belonging to a study group is negatively associated with the use of Smartphone for academic purposes in medical students of 40 Latin faculties. It is also concluded that almost seven out of ten students academically used Smartphone.

It is recommended to strengthen the use of Smartphone as a useful tool in the learning of evidence-based medicine and adequate decision-making in the educational activities of future doctors. Also, capture the interest of medical school authorities to ensure their educational use prior planning and training.

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Table 3: Independent factors associated with the academic use of smartphones in multiple regression analysis.

Variables		Bivariate analysis			Multiple regression, Model A parsimony*			B-M models of multiple regression adjusted by the parsimony*			Models**
		PR	IC 95%	*p*	PR	IC 95%	*p*	PR	IC 95%	*p*	
Gender											B
	Male	Ref.						Ref.			
	Female	1.16	1.06 - 1.26	0.001				1.16	0.97 - 1.39	0.106	
Age (years)*†		1.01	0.99 - 1.02	0.406				1.01	0.98 - 1.05	0.503	C
Country											D
	Ecuador	Ref.						Ref.			
	Panama	1.20	0.83 - 1.73	0.328				1.20	0.49 - 2.90	0.693	
	Paraguay	1.44	1.33 - 1.55	<0.001				1.38	0.85 - 2.25	0.198	
	Bolivia	6.48E-06	9.10e-07 - 4.62e-05	<0.001				5.75E-06	0 - .	0.980	
	Peru	0.88	0.60 - 1.28	0.508				0.79	0.42 - 1.50	0.476	
	México	1.28	1.00 - 1.63	0.047				1.15	0.55 - 2.40	0.703	
	Honduras	1.44	1.33 - 1.55	<0.001				1.47	0.37 - 5.93	0.587	
	Colombia	1.09	1.33 - 1.55	<0.001				1.29	0.93 - 1.77	0.123	
	Chile	1.09	0.96 - 1.24	0.194				0.98	0.71 - 1.35	0.915	
	Argentina	1.29	1.14 - 1.46	<0.001				1.24	0.88 - 1.74	0.217	
Type of university											E
	National	Ref.						Ref.			
	Private	1.02	0.93 - 1.12	0.672				0.94	0.76 - 1.16	0.584	
Clinical Courses†											F
	No	Ref.						Ref.			
	Yes	1.12	1.03 - 1.23	0.012				0.98	0.70 - 1.37	0.923	
Belongs to SOCEM											G
	No	Ref.						Ref.			
	Yes	1.10	0.97 - 1.24	0.142				0.98	0.75 - 0.89	0.800	
Belongs to research groups											H
	No	Ref.						Ref.			
	Yes	1.23	1.13 - 1.34	<0.001				1.12	0.79 - 1.57	0.527	
Belongs to academic groups											
	No	Ref.			Ref.						
	Yes	0.82	0.75 - 0.89	<0.001	0.82	0.75 - 0.89	<0.001				
Training in PubMed†											I
	Do not know	Ref.						Ref.			
	Not trained	0.98	0.86 - 1.11	0.735				0.99	0.74 - 1.32	0.944	
	Trained	0.98	0.87 - 1.11	0.795				0.96	0.74 - 1.24	0.767	
Training in SciELO†											J
	Do not know	Ref.						Ref.			
	Not trained	1.00	0.89 - 1.12	0.979				0.99	0.75 - 1.30	0.915	
	Trained	0.92	0.82 - 1.03	0.153				0.97	0.74 - 1.27	0.810	
Training in SCOPUS†											K
	Do not know	Ref.						Ref.			
	Not trained	0.89	0.75 - 1.04	0.145				0.91	0.68 - 1.22	0.546	
	Trained	1.26	1.17 - 1.35	<0.001				1.21	0.98 - 1.50	0.080	
Lend modern ICT†											L
	No	Ref.						Ref.			
	Yes	0.83	0.64 - 1.06	0.137				0.89	0.68 - 1.15	0.359	
Lend enough ICT†											M
	No	Ref.						Ref.			
	Yes	1.18	0.98 - 1.41	0.077				1.10	0.91 - 1.34	0.319	

* Values *p* obtained with multilevel mixed-effects generalized linear model (MEGLM, acronym in English), Poisson family, log link function, robust variance and cluster by university

** B-M models adjusted by variables of the parsimony model A SOCEM: Scientific Society of Medical Students. ICT: Information and Communication Technologies