

Assessment of Smartphone Addiction in Indian Adolescents: A Mixed Method Study by Systematic-review and Meta-analysis Approach

Sanjeev Davey, Anuradha Davey¹

Departments of Community Medicine,
Muzaffarnagar Medical College and Hospital,
Muzaffarnagar, Uttar Pradesh, India,
¹Departments of Community Medicine,
Subharti Medical College, Meerut, Uttar Pradesh, India

Correspondence to:

Dr. Sanjeev Davey,
B-197, 3rd Floor, Prashant Vihar, Sector
14 Rohini, New Delhi - 110 085, India.
E-mail: Sanjeevdavey333@gmail.com

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ABSTRACT

There is a considerable debate on addiction and abuse to Smartphone among adolescents and its consequent impact on their health; not only in a global context, but also specifically in the Indian population; considering that Smartphone's, globally occupy more than 50% of mobile phones market and more precise quantification of the associated problems is important to facilitate understanding in this field. As per PRISMA (2009) guidelines, extensive search of various studies in any form from a global scale to the more narrow Indian context using two key search words: "Smartphone's addiction" and "Indian adolescents" was done using websites of EMBASE, MEDLINE, PubMed, Global Health, Psyc-INFO, Biomed-Central, Web of Science, Cochrane Library, world library - World-Cat, Indian libraries such as National Medical Library of India from 1 January, 1995 to March 31, 2014 first for systematic-review. Finally, meta-analysis on only Indian studies was done using Med-Calc online software capable of doing meta-analysis of proportions. A total of 45 articles were considered in systematic-review from whole world; later on 6 studies out of these 45 related to Smartphone's addiction in India were extracted to perform meta-analysis, in which total 1304 participants (range: 165-335) were enrolled. The smartphone addiction magnitude in India ranged from 39% to 44% as per fixed effects calculated ($P < 0.0001$). Smartphone addiction among Indian teens can not only damage interpersonal skills, but also it can lead to significant negative health risks and harmful psychological effects on Indian adolescents.

Keywords: Meta-analysis, mobile phone abuse, mobile phone addiction, smartphone addiction, smartphones abuse, systematic-review

INTRODUCTION

Adolescents are defined as young people between the ages of 10 and 19 years as per WHO (2014) criteria.^[1] Today, 20% of people persons in the world are adolescents, constituting 1.2 billion people worldwide. Nearly, 243 million adolescents

live in India as per the UNICEF Report (2011).^[2]

Addiction is considered by WHO (WHO Expert Committee - 1964) as dependence, as the continuous use of something for the sake of relief, comfort, or stimulation, which often causes cravings when it is absent.^[3] The two major categories of addiction involve either substance addiction, e.g. "drugs or alcohol addiction" or "behavioral addiction such as mobile phone addiction."^[4]

Mobile phone addiction/abuse/misuse is one of the forms of compulsive use of "a mobile phone" by adolescents across the world. A new kind of health disorder in this category among adolescents, "smartphone's addiction/abuse/misuse" is now challenging health policy makers globally to think on this rapidly emerging issue. Indian adolescents are also affected by this high smartphone engagement, and the current paper will use meta-analysis to discuss their addictive behaviors.

A Smartphone, or smartphone, is a term for distinguishing mobile phones with advanced features from basic feature phones. The term "Smartphone" first appeared in 1997, when Ericsson described its GS 88 "Penelope" concept as a smartphone.^[5-8] This term was basically introduced in the market for a new class of mobile phones that provides integrated services from communication, computing and mobile sectors such as voice communication, messaging, personal information management applications and wireless communication capability.^[9]

Modern Smartphone's currently include all the features of a laptop, including web browsing, Wi-Fi, and 3rd-party apps etc., The most popular Smartphone's today which are emerging are Google's Android, Apple's IOS mobile operating systems and Nokia-X series.^[10-14] Significant increase in Smartphone use and their capabilities allow adolescents to access the Internet, communicate, and entertain themselves anywhere and anytime. Therefore, most teenagers in 10-19 years of age can use the Smartphone as a constant companion.

Worldwide scenario of adolescents vulnerability to Smartphone's

The age group of 25-34 is found to have the highest Smartphone usage rate of 62%. 50% of Android Smartphone's and 43% of Apple iPhone users are younger than 34 years.^[14,15] 53% of

Smartphone users are male and 47% are female.^[15] Indian teens are currently driving Smartphone's market in India The age group of 16-18 years using Smartphone's have shown a rapid rise from 5% in 2012-25% in early 2014.^[14,15] Recently in 2013, there were around "51 million" Smartphone users in Urban India and rate of rise from year 2012 was 90%.^[14,15]

Global Smartphone's addiction scenario

Smartphone abuse is increasing in the 21st century as more and more adolescents enjoy exploring their Smartphone's in their free hours. Smartphone overuse can be a sign of Smartphone addiction as per many studies of Kim and Flanagan.^[4,16] New research in US suggests that excessive use of Smartphone's, increases the risk for severe psychopathologies in adolescents and there is growing evidence of problematic use of Smartphone's that impacts both social and health aspects of users' lives.^[16,17] The study of 200 adolescents in Korea also showed that abnormal users of Smartphone's had significantly more problematic behaviors, somatic symptoms, attention deficits, and aggression and this study also found that youth were more addicted to Smartphone they had more severe psychopathologies.^[17]

Smartphone's addiction impacting health of adolescents

There are two questions that arise from the new way of using Smartphone's:^[18]

- The first is the issue of stress from constant connection to other people and decreased privacy
- The second issue is whether his new way of being online is going to make people more present in the virtual world at the expense at the real world?

Assessment of overuse or problematic use can actually depend on one time, self-reported behavioral information about Smartphone.^[19]

Developed countries scenario

There are many reports of people exhibiting problematic patterns of Smartphone abuse with potentially negative consequences on their familial, vocational and social lives after getting addicted to Smartphone's in developed countries such as US and UK.^[20,21] A University of Southern California

study found that the unprotected adolescent sexual activity was more common amongst owners of Smartphone's due to easy access to porn websites.^[22] A study conducted by the Rensselaer Polytechnic Institute's Lighting Research Center also concluded that smartphones, can seriously affect sleep cycles.^[23]

Smartphone's addiction emerging in Indian adolescents

A majority of adolescents from lower socioeconomic background in whole world; are not untouched by the effects by the widely available and cheaper Smartphone. Adolescents under 15 are also affected, in India and around the world. Moreover, little research has been conducted about smartphone use and its consequences. Considering the high rate of smartphone use among Indian adolescents, this area needs to be further explored, with a focus on what roles technology plays in fostering fantasies, acting out behaviors. Authors therefore aimed to explore problems emerging with this technology among Indian adolescents, so that best prevention and treatment strategies can be worked out-this is the prime reason why the authors have chosen and analyzed this area by meta-analysis and systematic-review of studies in this article.

METHODS

The assessment of emergence of smartphone abuse in Indian adolescents was done by a mixed method approach as per preferred reporting items for systematic-review and meta-analysis (PRISMA [2009]) guidelines for systematic-review and meta-analysis done by using Med-Calc online meta-analysis software.

Systematic-review strategy

Inclusion criteria

We searched for studies in any form on two key search words: "Smartphone addiction" and "Indian Adolescents" using websites of MEDLINE, EMBASE, Psyc-INFO, Global Health, PubMed, Biomed-Central, Web of Science, Cochrane Library, World library - World-Cat, Indian libraries such as National Medical Library of India from 1 January, 1995 to March 31, 2014 first for systematic-review. Out of 70 records searched from various sources, 45 studies were found eligible and

we used them for synthesizing our study findings theme-wise as shown in the flow diagram.

Exclusion criteria

Any kind of Internet addiction study carried out in both global and Indian set up was not considered.

Meta-analysis strategy

Inclusion criteria

We later on performed meta-analysis of only available 6 Indian studies on Smartphone addiction in India. We calculated effect estimates and we used both fixed as well random effects (REs) meta-analysis to give pooled estimates. Meta-analysis for this study on proportions was done by using Med-Calc online software.

Exclusion criteria

Studies related to Internet addiction and Smartphone's addiction from rest of world except India was not used in the meta-analysis.

Global demographic profile of Smartphone usage

The literature for our study did not reveal many journal articles on the abuse to multifunction smartphone devices. Hence, all kinds of studies in any form such as Internet-based research, thesis, dissertation and any kind of article available in print as well as digital form including e-journals and any article related to this topic including many research agencies and investment firm reports such Gartner and Canalys, first were considered in systematic-review and this revealed the following issues after synthesizing study findings as given below in Tables 1 and 2.^[5-23]

Meta-analysis findings

Six Indian studies were meta-analyzed by meta-analysis software MedCalc 13.1.0 version available online. This MedCalc uses a Freeman-Tukey transformation (arcsine square root transformation; Freeman and Tukey, 1950) to calculate the weighted summary proportion under the fixed and REs model (DerSimonian and Laird, 1986) and their results are given below in Tables 3, 4, Figures 1 and 2. Meta-analysis finding reveals that mobile phone (smartphone) usage has a significant effect in causing psychological problems, affecting classroom performance, hampering of studies, eating, stress, etc., When first two studies were separately analyzed by meta-analysis method the

Table 1: Demographic profile of global distribution of Smartphone's usage

Demographic variables	Usage in %
Age group wise usage	
11-24	72
25-34	62
35-44	56
45-54	39
55-64	30
65+	38
Sex wise usage (average)	
Male	53
Female	47
Smartphone's global usage statistics	
Percentage of people using Smartphone's on the average day	89
Percentage of Smartphone's users using for-"text messages"	92
Percentage of Smartphone's users using it for "Internet browsing"	84

findings on the effect of Smartphone usage on many variables among medical college students are shown in Table 3.

Table 4 and Figure 2 in forest plot reveals that although heterogeneity in these six studies was significantly higher, REs in studies were almost near to fixed effects (43.2% vs. 42.2% respectively), suggesting that smartphone abuse has significant effects on psychosocial issues in adolescents and hence we can say that magnitude of smartphone phone addiction ranges from 39% to 45% in fixed effects models.

DISCUSSION

Theme 1: Global and Indian Smartphone's usage scenario

Smartphone love has swept the world. Smartphone's technology is advancing at a rapid rate. However, the advancement of the technology is not what is alarming, but rather people's misuse and excessive engagement with their devices, so most of adolescents are exposed to the media applications and instant mobile broadband access involved with the evolution of Smartphone. Our systematic-review from the current theme, which we derived, found explosive growth of Smartphone's use in the world with its rapid penetration among adolescents in India.^[5-8,10-15] What would

be beneficial now, in light of the negative effects associated with excessive smartphone use, would be the development of a strategy for encouraging more responsible use of personal devices.^[9]

Global Smartphone's scenario

Developed countries

The smartphone world is expanding at a rapid rate; as data reveals that out of 5 billion mobile phone users found currently globally, 1.1 billion are smartphone users and majority of them are from the U.S (91 million).^[15] According to the International Telecommunication Union, the Smartphone penetration rate in the U.S. till June 2013 was 51%.

Developing countries

In developing countries such as Singapore; they have the highest Smartphone penetration rate in world, that is, 54% and on Smartphone platform Android they have the highest market share of 46.9%.^[15] Moreover, it has been found that 89% of smartphone users in Singapore used their smartphones during the whole day; 92% of Smartphone users used it to send text messages to other phones and 84% of used them for browsing the Internet.

Indian Smartphone's scenario

According to Canalis an investment firm of Singapore and research firm Gartner by 2017, there will be 15.6% smartphone users and annual rate of growth of smartphone users in India would be around 129%, even more than that of China (109%).^[15]

Theme 2a: Smartphone's addiction impacting global and Indian adolescents health

Systematic-review in our study revealed that smartphones cause a wide range of problems, spanning from abuse to addiction to the device, and affecting work and home life.^[16-17,19-20] Smartphone abuse and addiction may even become cause of an accident and ruining our personal or social life.^[18] Technology is now driving our life values and Smartphones are actually changing social relationships. Countries such as United Kingdom has declared themselves a "Smartphone addicted" country and 60% of UK teens admit that they are highly addicted to their Smartphone's.^[15,18,21] In another developing countries such as South Korea; the smartphone addiction rate among teenagers was found to be 18%, double the addiction rate

Table 2: Synthesis of themes from key global studies considered in systematic-review

Name of author of study with reference citation	Country of study	Study methodology-study design, sample size etc.	Key findings	Implications of studies	Key themes synthesized from studies
Ira; Ericsson GS88 Preview; "History". Stockholm Smartphone, Penelope-box ^[5-8] "Smartphone". Phone Scoop and Phone Scoop, ^[10-11] Nusca ^[12] Arthur ^[13] Katz and Akhus ^[14] Smartphone Users-Statistics and facts (Infographic) Canalis and Gartner Report ^[15] Sarwar and Soomro ^[9]	UAE, UK, US, India	Internet based studies on Go-gulf.com of investment and research firms	The age group between 25-34 years-highest Smartphone penetration rate	The Smartphone usage in world is expanding at a rapid rate. Annual rate of growth of Smartphone users in India-129%	Smartphone's usage scenario in world and India
Sarwar and Soomro ^[9]	UAE	Review-study, evaluation-based, (n=31)	Benefits of Smartphone are many and negative-impacts are minor	A strategy to stop/avoid the misuse of Smartphone's is required	Smartphone's impact on society
Sarwar and Soomro ^[9] Worldwide market share for Smartphone's ^[18] Canalis and Gartner ^[15,18,21] Flanagan ^[16] Brauser ^[17] Antao ^[19] Rush ^[20]	UK and US, Singapore and UAE	Thesis, Internet based online analysis and journal articles	Severe Smartphone overuse-a sign of Smartphone addiction. Smartphone addiction-associated with psychopathologies Unprotected and problematic adolescent sexual activity-more common in those with Smartphone's addiction	Social and health aspects of users' lives affected. Affecting sleep cycles, sexual activity etc.	Smartphone's abuse to addiction-impacting global and Indian adolescent health
Miller, Khan, Al-Khlaiwi and Meo, Laberge-Nadeau <i>et al.</i> , McCart <i>et al.</i> , Merlo <i>et al.</i> , Khosla and Sawhani, Dixit <i>et al.</i> ^[22-30]	US, UK, Saudi Arabia, India	Review-study, cross-sectional study, evaluation-based	Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance	Adverse effects of excessive mobile phone use can cause "BlackBerry thumb" to carpal tunnel syndrome, and child health problems	The Smartphone psychology and PUMP scale to measure problematic use of Smartphone's
Park and Lee, Bianchi and Phillips, Derks <i>et al.</i> , Lee <i>et al.</i> ^[31-34]	South Korea, UK, US, India	Review-study, cross sectional study, evaluation-based	Motives of Smartphone use were positively as well as negatively related to different relations. All high school students suffering from depression, anxiety and stress must be screened for Smartphone's addiction	Community concerns of mobile phones overuse-close link between continued problematic Internet use and the phenomena of PLEs	WHI due to mobile phone interference SAMS for objective assessment and intervention

Contd...

Table 2: Contd...

Name of author of study with reference citation	Country of study	Study methodology- study design, sample size etc.	Key findings	Implications of studies	Key themes synthesized from studies
Bengt <i>et al.</i> , Avvannavar <i>et al.</i> , Kapdi <i>et al.</i> , Khurana <i>et al.</i> , Subba <i>et al.</i> , Jain and Kakkar, Aggarwal <i>et al.</i> , MACRO and Neha <i>et al.</i> ^[35-44] Pedrero Pérez <i>et al.</i> ^[45]	UK, US, India US	Anthropological- review of literature. Cross-impact analysis (n=15) Review	Mobile ban can reduce cultural invasions, phenomena, decreased time spent on mobile phones. Problem in relation to mobile phone use but the vagueness of the cell phone addiction exists	Direct and indirect impacts	Smart phone health risks: societal, environmental and economical

SAMS=Smartphone Addiction Management System, WHI=Work-home interference, PUMP=Problematic use of mobile phone, PLEs=Psychotic-like experiences

Table 3: Effect of mobile phones usage on individual psycho-social factors of medical college students

Names of authors- with year of study	Study of effect of mobile phone usage on other variables	Statistical values considered from study	Cohen's d	95% CI		Cramer's V
				LCI	HCI	
Subba <i>et al.</i> ^[40]	n=336					
	Number of persons with whom students talked on phone most often	n=335, $\chi^2=20.5$	0.51	0.28	0.73	0.01
	Ringxiety	n=113				
	Classroom usage	n=114, P=0.019	0.49	0.11	0.87	0.03
	Studies hampered	$\chi^2=12.7$, n=56, P=0.0001	1.08	0.48	1.6	0.09
Dixit <i>et al.</i> ^[30]	n=200					
	Students borrowed money from friends to pay	$\chi^2=0.003$, n=51	0.015	-0.53	0.56	0.07
	Stress due to network inaccessibility/ phone malfunction	n=128, P=0.002	0.56	0.2	0.9	0.03
	Presence of nomophobia/used mobile phone during college hours	n=37	0.68	0	1.3	0.12
	Keep their mobile phones with them even when they go to sleep (for 24 h a day)	n=146	0.32	0	0.65	0.02
	Lose their concentration and become stressed when they do not have their mobile	n=40	0.65	0	1.3	0.11
	Upgrade their mobile software at least once a year	n=50	0.57	0	1.1	0.08
	Mobile phone is a necessary tool to help them	n=166	0.3	0	0.61	0.02
	keep connected with their family members	n=79	0.45	0	0.9	0.05
	Keep on checking their mobile phones for messages and calls	n=62	0.51	0	1	0.06
Students used it when absolutely necessary	n=19	1	0	2	0.26	

CI=Confidence interval, LCI=Lower limit of confidence interval, HCI=Higher limit of confidence interval

of 9.1% for adults, as/their government survey in South Korea.^[15]

Problematic sexual behavior through Smartphone's

It has been found that nearly 3-5% of the

online population is found to have problematic sexual behavior which is rapidly evolving due to the easy and increasing accessibility of online sexual content and the immediate connectivity

Table 4: Meta-analytic findings of study

Name of author of study with year and citation	Sample size (n)	Magnitude of Smartphone abuse (%)	95% CI
Subba <i>et al.</i> , 2013	335	78.8	74.0-83.0
Dixit <i>et al.</i> , 2010 ^[30]	200	18.5	13.3-24.5
Jain and Kakkar 2013	200	69.5	62.6-75.7
Aggarwal <i>et al.</i> , 2013	192	23.9	18.1-30.6
MACRO 2004	165	58.1	50.2-68.2
Neha <i>et al.</i> , 2012	212	58.0	51.0-64.7
Total (FE)	1304	42.2	39.5-44.9
Total (RE)		1304	
		43.2	
		27.1-60.0	
Tests for heterogeneity	$Q=192, df=5, P<0.0001, I^2$ (inconsistency) =97.4%, 95% CI for inconsistency=95.9-98.3		

CI=Confidence interval, FE=Fixed effect, RE=Random effect

now provided by cheaper Smartphone's and social networks.^[6,12]

Smartphone's Mania among adolescents: Famous South Korean example

South Koreans are among the world's biggest tech users, which is posing many problems such as: (a) South Korea has reached a mobile-phone usage rate of more than 100% and smartphones represent nearly two-thirds of those devices.^[18] (b) The smartphone-penetration rate in South Koreans children ages 6-19 tripled to 65% last year from a year earlier, according to the Korea Communications Commission.^[18]

Theme 3a: The Smartphone psychology

Eighty-four percent people worldwide are addicted to smartphones. With wider and increasing number of mobile apps and Web sites, it's time to leverage students' addiction to Smartphone's and teach them information literacy in a mobile setting. 81% of smartphone users have their mobile phone switched on all of the time even when they are in bed or in bathrooms.^[18-22] By 2025, more than 5 billion people of world will be using ultra-broadband, sensor-rich Smartphone's.^[22] In Saudi Arabian studies, 44.4% of adolescents to their excessive mobile phone use had common health complaints such as headache, trouble concentrating, memory loss, hearing loss, and fatigue.^[23-26]

Theme 3b: Problematic use of mobile phone (PUMP) scale to measure PUMPs

Another Saudi Arabian study suggested that 3-4% of mobile phone users show symptoms such as tension, fatigue, sleep disturbance, and dizziness related to their mobile phone use, and >20% complain of headaches and accidents due to distracted driving. Considering that this is a public health issue, so the use of the PUMP Scale to measure problematic use of mobile phones is needed as an essential tool.^[27]

Theme 3c: Indians Smartphone's addiction

Indians teens love their Smartphone. Nokia research reveals that an average person checks the phone every 6.30 min in a 16 h waking cycle. Of the 20-25 people, at least 10% face smartphone and computer-related injuries in the 20-45 age group. These are usually upwardly mobile patients who are constantly looking at their phone in a bent-forward position. They complain of their backs stiffening up, developing a stoop and text neck besides the tendons in their thumbs hurting when they text. Tendon injuries, carpal tunnel syndrome, radiation related problems, inattention blindness and computer vision syndrome are common ailments that stem from unrelenting mobile usage.^[28]

Playing with smartphones also hinder toddler's brain development. A recent survey conducted by a cartoon channel in India revealed that 95% of kids live in homes with a mobile phone while 73% of Indian kids are mobile phone users. Interestingly, of these, 70% fall under the age group of 7-10 years while 76% are in the age group of 11-14 years. Most families, especially in metros, do not use landlines at all. And since both parents have mobile phones, a child has access to it since a very young age. Addiction to technological gadgets at an early age also discourages kids to engage in physical activities, leading to instances of obesity. Experts believe that handing over the gadget to a kid who is as young as 7 years may not be a good idea as it can be detrimental to his/her physical and mental health.^[29]

Nomophobia

Defined as "fear of being without your phone;" is an emerging problem of the modern era in India also, as found in a study on mobile phone dependence among students of M. G. M. Medical College, Indore (India) by Dixit *et al.*^[30]

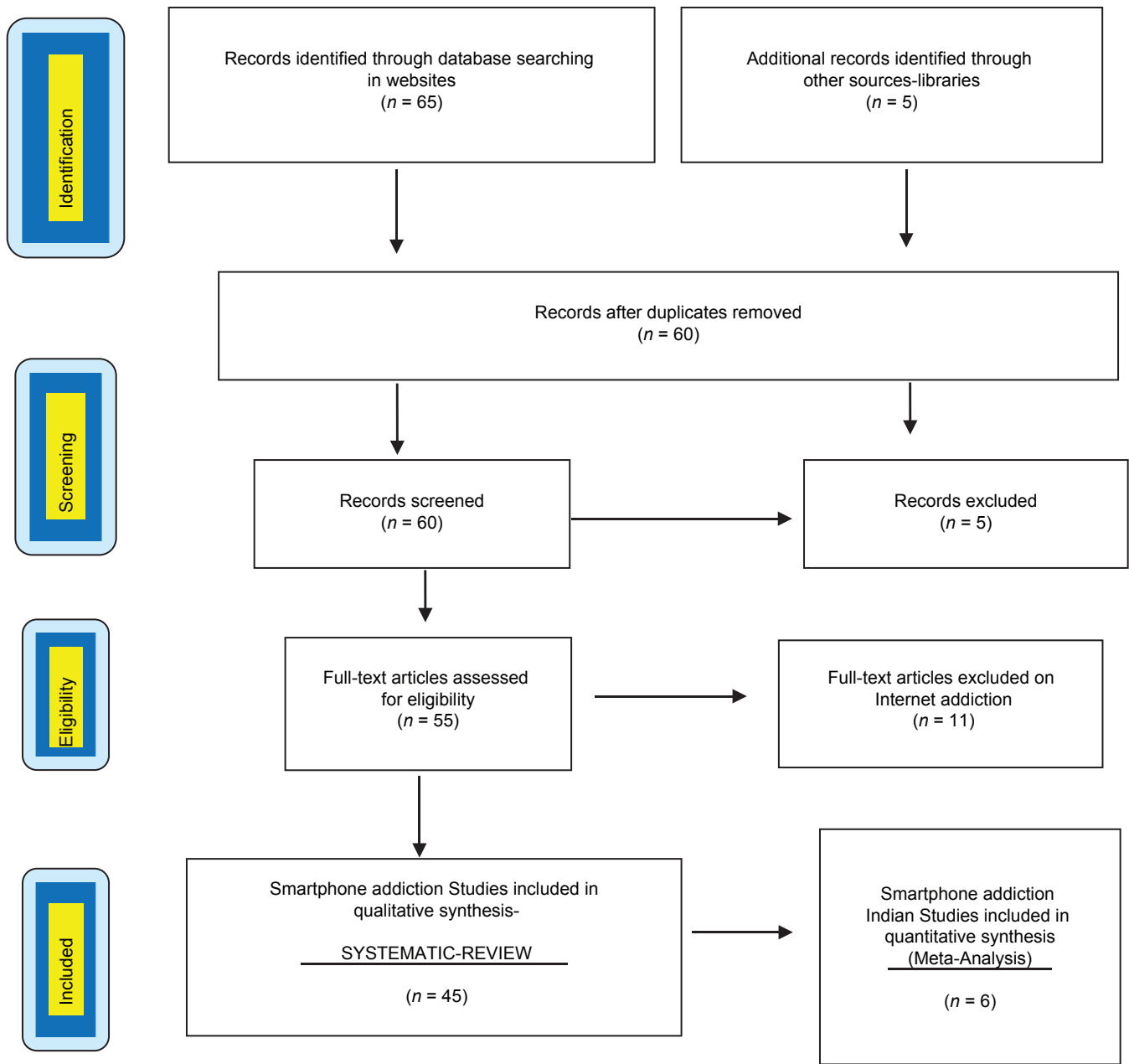


Figure 1: Study selection process as per PRISMA (2009) guidelines

Theme 4: Smartphone health risks: Societal, environmental and economical

In study of social implications of smartphone use in Korean college students Park *et al.* found that the motives for smartphone use were positively and negatively related to many kinds of relations. The hierarchical multiple regression analysis which they found had the associations among motives of smartphone use, social relations, perceived social support, and variables of psychological well-being.^[31]

A study by Bianchi and Phillips also reveals similar issues - that community concern on mobile phone overuse exists, and we should identify groups that should be targeted in intervention campaigns.^[32] A study by Derks also reveals that the extensive use of smartphones with its implicit request of 24/7 availability inhibits the process of engaging in activities that are required for daily recovery and work-home interference is an important inhibitor of the recovery process.^[33]

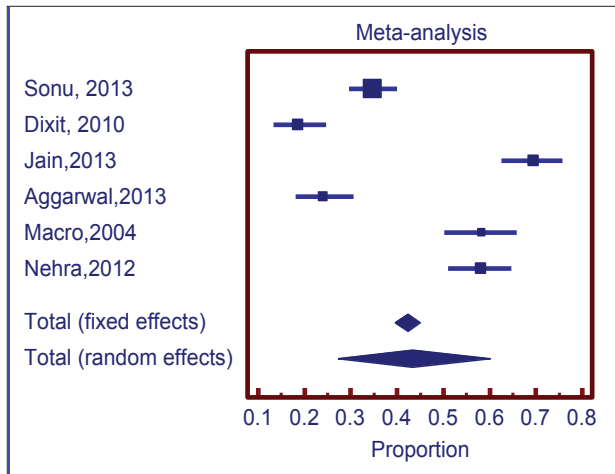


Figure 2: Forest plot showing fixed and random effect size of mobile phone usage

Role of smartphone addiction management system

So what is currently required is a comprehensive Information and Communications Technology system such as smartphone addiction management system (SAMS) for objective assessment and intervention, which was suggested in a study by Lee *et al.*^[34] This comparative study was done on 14 users who were 19-50 year old adults and suggested that, this system can consist of an Android smartphone application and a web application server and the SAMS client monitors the user's application usage together with GPS location and Internet access location. The field trial also fully verified the accuracy of the time, location, and Internet access information in the usage measurement and the reliability and utility of this kind of system.^[34]

Emerging health risks of Smartphone's abuse and addiction on Indian adolescents

Smartphone usage behaviors' e.g. duration of usage and use of mobile phones for accessing Internet are found to be the main risks which can increase likelihood of hazards resulting from mobile phone use. Excessive smartphone use by Indian teens may even damage interpersonal skills of adolescents. Smartphone dependence can cause: (a) Stress (b) anxiety (c) insomnia (d) depression (e) delinquency (f) aggressiveness.^[5] Some mobile phone users also run under debt, and that mobile phones can violate privacy, and can harass others as found in

USA.^[35] Excess of smartphone usage before bed can also cause insomnia, as it was found that the laboratory exposure to 884 MHz wireless signals, components of sleep believed to be important for recovery from daily wear and tear were adversely affected as found in Chicago so Indian adolescents also have similar kind of risk.^[3,35] Another comparison study showed that high daily use count as a strong correlation with risk scores.^[36] A cross-impact analysis study on key 15 social impact indicators conducted by Avvannavar *et al.* in India; also revealed that although a ban of the mobile phones at various places, can curtail the emerging addiction of mobile phones among adolescents in India, but this is a controversial issue.^[37] Studies by Kapdi *et al.* and Khurana *et al.* has also stressed on health hazards of electromagnetic radiation exposure in terms of thermal and nonthermal effects from mobile phones addiction as well as from their mobile base stations.^[38-39]

A significantly larger proportion of ringxiety sufferers also complain of hampered studies, apart from the fact the pattern of mobile phone use even among the medical students of India is problematic, as a large proportion of medical students suffer from ringxiety, they reported getting very upset and they used their phones at restricted times and places such as classrooms and practical labs, as found in study by Subba *et al.*^[40]

Although several studies on mobile phones usage pattern on youngsters across the world such as Japan, Norway, Finland, USA, and Britain were done in past; only few study on usage patterns of mobile phones by youngsters in India have been done such as one by Jain and Kakkar.^[41] Excessive use of Smartphone's leads to addiction which impacts; work performance and negative health consequences found also among Indian resident doctors, making this situation more grim as studied by Aggarwal *et al.*^[42] 58% mobile phone addiction prevalence in Mumbai teens and youth was also reported by MACROS organization in 2004, which also finds this problematic magnitude irrespective of age and gender.^[43] Excessive use of mobile phones as studied on 212 young Indian adults is reflecting it a behavioral addiction, as suggested from their by Neha *et al.*^[44]

The estimated prevalence of mobile phones overuse as found by Pedrero Pérez *et al.*^[45] in USA found it ranging between 0% and 38%; depending

on the scale used and the characteristics of the population studies and this study also recommended that a problem exists in relation to mobile phone use, the vagueness of the cell phone addiction concept is still remains in literature and this finding was similar to our study also, as magnitude of Smartphone's abuse was between 39% and 44%, with a variability ranging from abuse to addiction.

What this study contributes?

Characteristic features of emerging smartphone's-abuse to addiction in Indian adolescents

- The adolescents are constantly preoccupied with smartphones all the day
- An inability to restrict smartphone use despite of knowing harmful effects
- Restlessness, anxiety and severe craving when no using the phone
- Sleeping with the phone nearby and repeatedly waking up to check for a message, status update, etc.

Limitations of study

Too small sample size of six studies in meta-analysis can be a limiting factor in generalization of findings from study, as file drawer effect may also occur due to noninclusion of all unpublished data despite all efforts in searching literature. Approach of first systematic-review of global studies and later on meta-analysis of only Indian studies may have methodological concerns and can also be a debatable issue.

CONCLUSIONS

Increase in the use of smartphones in societies, has raised concern about social and psychological effects of excessive use of smartphone's especially among Indian adolescents. Smartphone's have made mobile connectivity so accessible that today's Indian generations are abusing their Smartphone. Smartphone abuse to addiction has become more serious since adolescents can download and run numerous applications with smartphone even without Internet connection. Smartphone addiction are is still not sufficiently addressed within studies in literature, so what is suggested is more in-depth qualitative and quantitative studies in the future with larger sample sizes, and the development of policies to raise awareness about this issue by Indian governments for better future of Indian adolescents as a priority action.

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