ORIGINAL ARTICLE

IMPLICATIONS OF SMART PHONE ADDICTION ON MENTAL HEALTH AND ACADEMIC PERFORMANCE OF MEDICAL STUDENTS

Hamid Hassan, Marwah Asif Lodhi*, Muhammad Ahmad*

Department of Physiology, *Final Year MBBS Student, Nishtar Medical University, Multan, Pakistan

Background: Smartphone-addiction shatters neuro-physiological harmony. This study aimed to associate smartphone-addiction with indices of psychiatric health and academic performance. **Methods:** Study population was segregated into smartphone non-addict (SNA) and smartphone-addict (SA) groups on basis of Smartphone Addiction Scale-Short Version (SAS-SV), with an equal representation of males (SAS-SV≤31 for SNAs and >31 for SAs) and females (SAS-SV≤33 for SNAs and >33 for SAs). Degree of depression, anxiety and stress was assessed using Depression Anxiety Stress Scale (DASS-21) while latest annual academic score (AS) was considered as an indicator of academic performance. **Results:** Collective prevalence of mental unrest was found to be 18.45% within SNAs and 75.0% in SAs. Intensity of depression, anxiety and stress within smartphone non-addict males (SNAMs) and smartphone non-addict females (SNAFs) was significantly lower than their SA counterparts [(p=0.00, p=0.01), (p=0.00, p=0.00) and (p=0.01, p=0.00) respectively] while smartphone addict females (SAFs) harboured significantly higher degree of anxiety (p=0.02) as compared to smartphone addict males (SAMs). Within SAMs and SAFs, degree of smartphone addiction showed positive correlation with depression (rho=0.46, p=0.00 and rho=0.37, p=0.02), anxiety (rho=0.71, p=0.00 and rho=0.40, p=0.01) and stress (rho=0.69, p=0.00 and rho=0.77, p=0.00) while negative with AS (rho= -0.83, p=0.00 and rho= -0.73, p=0.00). SAMs and SAFs showed independent negative correlation of their AS with depression, anxiety and stress too [(rho= -0.49, p=0.00 and rho= -0.48, p=0.00), (rho= -0.76, p=0.00 and rho=-0.48, p=0.00) and (rho= -0.71, p=0.00 and rho= -0.89, p=0.00) respectively]. **Conclusion:** Smartphone addiction establishes psycho-psychiatric upheaval.

Keywords: Smartphone, addiction, depression, anxiety, students, medical education, academic score

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INTRODUCTION

Addiction is a psycho-psychiatric state characterized by an irresistible urge for using a substance to an extent where it starts to brew social derangements, bio-physical dysregulations and psychological abnormalities within an addict's routine life.[1] The term addiction, once restricted to abuse of biochemical substances only, now encompasses domains associated with overuse of smartphones, internet and/or online games[2] as well, since their global usage has started to exhibit an addictive uptrend over the past decade or so. According to recently published statistics number of smartphone users in the world has exceeded the figure of 7.10 billion, with more than 185.62 million smartphone users existing within Pakistan[3], but demographic data pertaining to the existence of smartphone addicts either globally or within Pakistan is yet not available.

Since smartphone equips its user with the means and fora for acquirement of social validation through projection of an aspired social image of oneself, hence it creates a tendency within a smartphone user for repetitive stimulation of reward circuits in an effort to achieve this aura of self-appeasement and pleasure.[4] This not only provides base for the development of smartphone addiction but also creates a fertile ground for evolution of stress (defined as the sequalae of excessive workload within a specific time bracket to meet one's expectation/s[5]) which later depicts itself within the spectrum of either depression (a psychological condition characterized by feelings of dejection, desolation, passivity as well as suicidal intentions[6]) and/or anxiety (a psychosomatic anomaly characterized by stressful notions that lead to systemic upheavals manifesting in the form of elevated heart rate, cold sweats and generalized shakiness[7]).

It is believed that repeated stimulation of reward circuitry within a smartphone-dependent individual for sustenance of a state of self-elation leads to persistent presence of dopamine within these circuits which not only dysregulates dopaminergic neurophysiology but also alters neuro-biochemistry as well as the neuro-functioning of other key modulators of human mood and emotions like serotonin, specifically within the circuits of hypothalamus, that in turn leads to development of depressive spectrum of stress.[8] Moreover, same dopaminergic as well as serotonergic dysregulations within reward circuitry of an individual addicted to smartphone usage also lead to higher secretion of Corticotrophin Releasing Hormone (CRF) from the circuits associated with amygdaloid body, which depicts itself in the form of stress as well as its associated diaspora of anxiety.[9]

In addition to the aforementioned neuro-chemical derangements associated with addictive

smartphone usage, continuous exposure to blue light emitting from a smartphone screen desynchronizes circadian rhythm through mutations of brain and muscle Arnt-like protein-1 (BMAL1), neuronal PAS domain protein 2 (NPAS2) as well as period circadian clock 2 (PER2) genes.[10] The resulting dysfunctional sleep-wake cycle in turn accentuates the probability for emergence of mental chaos within SAs by dysregulation of the cellular signalling that is to be carried out by prime mood modulators like dopamine, glutamate and Gamma-aminobutyric acid (GABA).[11]

A deregulated circadian rhythm within SAs, apart from bringing havoc to the neuro-biochemistry of mood circuitry, also disrupts structural modulations essential for hippocampal neurogenesis that serve as a prelude for a significant reduction of hippocampal volume.[12] This brings about changes within the capacity of smartphone dependent folks to retain facts that causes significant academic decline of theirs.[13]

Keeping in view the non-availability of adequate data that links smartphone usage with indices of psycho-psychiatric health in statistical terms, this study not only tried to link smartphone use dependency with the degree of depression, anxiety and stress but also attempted to associate smartphone addiction as well as psychiatric crisis related to this dependency with decline of academic productivity.

MATERIAL AND METHODS

The approval for conduction of this cross-sectional study was taken from the Institutional Review Board of Nishtar Medical University, Multan, Pakistan, and it was conducted at various medical institutes of the town between Nov 2021 and Apr 2022. The sample size that dictated inclusion of 28 subjects within each of the study group was calculated with a power of 90% and an alpha level of 5% by using the following formula, after inserting in the values from a contemporary study.[14]

$$n = \frac{\sigma^2 (Z_{1-\alpha/2} + Z_{1-\beta})^2}{(\mu_0 - \mu_1)^2}$$

Since obesity itself can affect the mental health in an independent fashion hence, in order to ensure the omission of confounders within our data to be collected, we only included non-obese medical students (males with a BMI of <22.9 and WHR of ≤0.9, females with BMI of <22.9 and WHR of ≤0.8) in our study after their written consent. Subjects who were considered obese as per WHO's 2000 and 2015 criteria for South Asian population, individuals with genetic obesity, those already diagnosed with psycho-psychiatric and/or endo-metabolic disorders as well as those with the history of exposure to domestic violence or recreational drug abuse were excluded from the study.

A general pool of non-obese population, selected through WHO 2000 Guidelines (for BMI) and WHO 2015 guidelines (for WHR), was later administered Smartphone Addiction Scale-Short Version (SAS-SV, Cronbach's α=0.967[15]) questionnaire whose scoring helped us segregate this pool of non-obese participants into smartphone non-addict (SNA) and smartphone-addict (SA) groups on convenience basis. To ensure that our study could also observe gender-based differences pertaining to study parameters, both SNA and SA groups were allotted an equal gender representation with 28 individuals falling into each of the gender-based subcategory of theirs. Thus, the control population of smartphone non-addict males (SNAMs) (SAS-SV score ≤31) and smartphone non-addict females (SNAFs) (SAS-SV score ≤33) while the study population of smartphone-addict males SAMs (SAS-SV >31) and smartphone-addict females (SAFs) (SAS-SV >33) collectively consisted of 112 subjects. To analyse the degree of depression, anxiety and stress carried by the selected subjects of SNAs and SAs, Depression, Anxiety and Stress Scale–21 (DASS-21, Cronbach's α=0.88[16]) was utilized while later to this score of their earliest annual examination was considered as an indicator of their academic performance.

The collected data, gathered on a specifically developed field proforma, was analysed using SPSS-26 where it was evaluated first for normality distribution through the application of Shapiro-Wilk's and Kolmogorov Smirnov's tests. Since the majority of study variables had a non-normal distribution, hence non-parametric statistical analysis was chosen to draw inferences for our data. For this, Kruskal Wallis test in association with Mann Whitney U test was applied to judge the existence of differences among depression, anxiety, stress as well as academic scores of all study groups while Spearman's rho correlation was applied to correlate various study variables with each other in all of the four study groups.

RESULTS

Since majority of study variables were non-normally distributed, the data has been represented as Median and IQR utilizing which, basic demographic details of all the study groups have been presented in Table-1.

Collective prevalence of mental unrest was found to be 18.45% within SNAs and 75.0% in SAs. Scores of depression, anxiety and stress of both SNAMs and SNAFs were significantly lower than their SA counterparts. Inferential statistics highlighted that the academic performance of male and female medical students who did not harbour smartphone use addiction was significantly better than those medical students who were addicted to smartphone use with male medical students performing significantly better than female medical students within the population carrying smartphone addiction. (Table-2).

Both within the male and female substrata of SNA as well as SA populations, smartphone dependency showed a positive correlation with the degree of stress, anxiety and depression but a negative one with academic performance. (Table-3).

SNAM and SAM as well as SAF participants showed an inverse correlation of their academic performance with degree of depression, anxiety and stress in a fashion independent of smartphone addiction too while SNAFs showed an independent negative correlation of their academic performance with degree of their depression and anxiety only. (Table-4).

Table-1: Demographic data pertaining to SNAMs, SNAFs, SAMs and SAFs

Demographics [Median (IQR)]	SNAMs	SNAFs	SAMs	SAFs
Age (Years)	20 (19–21)	20 (18–22)	20 (18–21)	19 (18–21)
Weight (Kg)	60.55 (47–74)	50 (42–63)	61.35 (49–67)	50.75 (40–60)
Height Square (m^2)	2.94 (2.46–3.28)	2.55 (2.16–2.92)	2.91 (2.50–3.28)	2.5 (2.19–2.72)
Body Mass Index (Kg/m^2)	21.05 (18.62–22.86)	19.84 (18.51–3.81)	20.77 (18.67–22.94)	21.26 (18.07–22.91)
Waist Circumference (Cm)	77 (67–93)	66.50 (60–79)	76 (63–86)	70 (55–80)
Hip Circumference (Cm)	90 (80–108)	88.50 (78–99)	91.50 (79–99)	90 (69–97)
Waist Hip Ratio	0.85 (0.77–0.90)	0.78 (0.64–0.80)	0.85 (0.70–0.89)	0.78 (0.73–0.84)

Table-2: Comparison of SAS-SV, DASS-D, DASS-A, DASS-S and AS of SNAMs, SNAFs, SAMs, SAFs

Variable	Groups in comparison (n=28)		*p*
SAS-SV [Median (IQR)]	SNAMs: 17 (11–23)	SNAFs: 18 (12–24)	0.21
	SAMs: 33 (31–45)	SAFs: 50 (44–57)	0.00
	SNAM: 17 (11–23)	SAMs: 33 (31–45)	0.00
	SNAFs: 18 (12–24)	SAFs: 50 (44–57)	0.00
DASS-D [Median (IQR)]	SNAMs: 4 (0–20)	SNAFs: 6 (2–18)	0.01
	SAMs: 10 (0–20)	SAFs: 10 (0–20)	0.53
	SNAMs: 4 (0–20)	SAMs: 10 (0–20)	0.00
	SNAFs: 6 (2–18)	SAFs: 10 (0–20)	0.01
DASS-A [Median (IQR)]	SNAMs: 3 (0–18)	SNAFs: 4 (0–10)	0.42
	SAMs: 8 (0–16)	SAFs: 12 (0–20)	0.02
	SNAMs: 3 (0–18)	SAMs: 8 (0–16)	0.00
	SNAFs: 4 (0–10)	SAFs: 12 (0–20)	0.00
DASS-S [Median (IQR)]	SNAMs: 8 (0–24)	SNAFs: 8 (2–24)	0.65
	SAMs: 16 (0–24)	SAFs: 18 (2–32)	0.09
	SNAMs: 8 (0–24)	SAMs: 16 (0–24)	0.01
	SNAFs: 8 (2–24)	SAFs: 18 (2–32)	0.00
Academic Score [Median (IQR)]	SNAMs: 68.50 (62–73)	SNAFs: 68.50 (57–77)	0.52
	SAMs: 62 (52–75)	SAFs: 59 (49–67)	0.00
	SNAMs: 68.50 (62–73)	SAMs: 62 (52–75)	0.00
	SNAFs: 68.50 (57–77)	SAFs: 59 (49–67)	0.00

Table-3: Correlation of DASS-D, DASS-A, DASS-S and AS with SAS-SV in SNAMs, SNAFs, SAMs and SAFs

	SAS-SV							
	SNAMs		SNAFs		SAMs		SAFs	
Parameters	rho	*p*	rho	*p*	rho	*p*	rho	*p*
DASS-D	0.43	0.01	0.51	0.00	0.46	0.00	0.37	0.02
DASS-A	0.41	0.01	0.52	0.00	0.71	0.00	0.40	0.01
DASS-S	0.42	0.01	0.32	0.04	0.69	0.00	0.77	0.00
AS	-0.65	0.00	-0.52	0.00	-0.83	0.00	-0.73	0.00

Table-4: Correlation of DASS-D, DASS-A and DASS-S with AS in SNAMs, SNAFs, SAMs and SAFs

	AS							
	SNAMs		SNAFs		SAMs		SAFs	
Parameters	rho	*p*	rho	*p*	rho	*p*	rho	*p*
DASS-D	-0.53	0.00	-0.69	0.00	-0.49	0.00	-0.48	0.00
DASS-A	-0.51	0.00	-0.53	0.00	-0.76	0.00	-0.48	0.00
DASS-S	-0.53	0.00	-0.09	0.31	-0.71	0.00	-0.89	0.00

DISCUSSION

Both SAMs and SAFs experienced a significantly higher degree of depression as compared to their SNA counterparts. This is in accordance with results of a recent contemporary study and could be justified through scientific portrayals of some which suggest that smartphone addiction, in a manner similar to addiction of biochemical substances, leads to serotonin imbalance as well as serotonin receptor plasticity[17] within the key mood-controlling areas of the limbic system which in turn becomes the base over which mood disorders like depression do thrive.

SA subjects, regardless of their gender, carried significantly higher degrees of anxiety and stress as compared to SNAs. This too is in accordance with the data published by a related research[18] and could be validated through neurophysiological grounds established by studies which suggest that blue light, emitted by smartphone screens, causes melatonin imbalance[19] that leads to over-secretion of norepinephrine within the circuits associated with centres like locus coeruleus which than initiates the evolution of anxiety as well as stress through a deregulated sympathetic outflow[20].

We came across certain findings that we were not already anticipating. SAFs of our study not only harboured higher degree of smartphone addiction as well anxiety but also performed poorly on academic front as compared to SAMs. A more intense shade of smartphone addiction within the female strata of our study population is most likely to have emerged as part of a strategy primarily evolved to secure an escape from harsh domestic and social pressures that generally affect the females of our society. A repetitive acquisition of this escapist strategy in SAFs thus creates a neuro-psychiatric vulnerability over which a spectrum of anxiety can thrive.[21]

Smartphone addiction showed a positive correlation with indices of psychiatric health, all of which in turn showed a negative correlation with academic aces not only in SNA but also in SA medical students. This once again is similar to the findings presented by a research lately[22] and can be explained by the conclusions of others which do portray that smartphone use through overstimulation of the hypothalamo-pituitary-adrenal axis scripts a prelude over which both stress disorders as well as short and long term memory loss can thrive[23]. This thus becomes a valid reason for poor fact retention as well as poor academic performance of medical students who stay hung to their smartphones.

SNAM and SAM as well as SAF participants depicted a negative correlation of their academic scores with intensity of depression, anxiety and stress in a manner independent of smartphone addiction while SNAFs indicated an independent negative correlation of their academic performance with severity of their depression and anxiety only. This finding of ours is also echoed within recently published literature and could be justified through the facts documented by some which declare that depression, anxiety and stress not only shatter the intellectual focus but also lower the cognitive abilities, both of which can prevent mentally stressed individuals from acing within academic pastures.[24]

We also came across another incidental finding and noted that nearly a quarter of medical students who were not dependent on smartphone usage were carrying the undiagnosed burden of mental disorders including an overlapping spectrum of depression, anxiety and stress. This non-anticipated finding of ours is however supported by similar descriptive studies[25] conducted on general Pakistani population where the undiagnosed prevalence of moderate degrees of anxiety and depression has been found to be equivalent to 34% and 24.8% respectively while the prevalence of severe forms of undiagnosed spectrum of anxiety and depression has been found to be in equivalence of around 7.2% and 1.0% respectively. It indicates that a considerable proportion of mental disorders stays underdiagnosed within Pakistani social texture and could therefore extend the basis for what is being endured by our community at hands of an ever-increasing proportion of society depicting an uptrend for suicidal as well as homicidal and criminal inclinations in the current era.

CONCLUSION

On the basis of discussion crafted above, we conclude that smartphone addiction in students creates mental instability which via shattering intellectual focus and memory retention leads to poor academic performance.

OUTCOME AND UTILIZATION

Our study, thus equips educationists, psychiatrists as well as clinicians with valuable data on base of which they could be sensitized not only to the chaos initiated by smartphone within psychiatric harmony of youngsters but also regarding the existence of unregistered and subtle forms of mood disorders within their vicinity. This sensitization in turn can help the responsible circles of our society to comb, identify as well as treat the currently under-diagnosed and mismanaged forms of behavioural as well as mood disorders avidly.

LIMITATIONS

The major limitation of this study however stands to be its dependency on a single time observation, rather than on a series of successive observations, that did pertain to public of South Punjab only. This creates a possibility that the results could differ within a cohort study design that observes multiple strata of the multiple areas of country and hence, we do recommend similar cohort studies for future researchers.

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Address for Correspondence:

Dr Hamid Hassan, Department of Physiology, Nishtar Medical University, Multan, Pakistan. **Cell:** +92-333-6107738
Email: ssaaqii@gmail.com

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Contribution of Authors:

HH: Conception, Commencement, field work, statistical analysis and primary scripting
MAL: Acquisition, analysis, interpretation of data as well as drafting and revision of initial script
MA: Acquisition, analysis, interpretation of data as well as drafting and revision of initial script

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