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Smartphone addiction and mental health among adolescents: A cross-sectional study

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Abstract
Adolescent smartphone addiction has become a major worry, with possible effects on everyday functioning and mental health. This research looks at how common smartphone addiction is, how it affects sleep quality, physical activity, and self-esteem, and how it relates to mental health conditions including stress, anxiety, and depression. Data were collected from a sample of adolescents using standardized questionnaires Smartphone addiction scale short version and DASS-21 using structural equation modelling (SEM) to evaluate smartphone addiction and related behavioural and psychological effects. The results show a strong positive correlation between greater degrees of smartphone addiction and higher degrees of stress, anxiety, and sadness. Furthermore, there is a clear correlation between smartphone addiction and less physical activity and lower sleep quality. Despite a negative association, there was no statistically significant link with self-esteem. The robustness of these results is supported by model fit indices, which further emphasize the significant negative effects of smartphone addiction on everyday functioning and mental health. The findings highlight the need of focused initiatives to lessen the negative impacts of excessive smartphone usage and encourage teenagers to develop healthy digital habits.

Keywords: Smartphone addiction, mental health, depression, sleep quality, physical activity.

Introduction
Over the last several years, cell phones have become a necessity in people's everyday lives everywhere [1]. When the first smartphone was made accessible to the general public in 2007, the mobile industry has advanced technologically. Because of the tremendous advancements in the field of e-technology, the world is changing very quickly. It is hard to ignore technology in today's fast-paced, cutthroat society, and using a smartphone is only one example. More often than not, smartphones are used as portable computers for setting up daily calendars, storing bulky documents, viewing films, listening to music, communicating with friends, using social networking sites, participating in video conferences, and much more [2]. Over 6 billion people, or approximately 83.72% of the world's population, will be using smartphones in 2022, according to Statista, with youth users making up the majority of users [3].

Compulsive use of smartphones is becoming an increasingly widespread problem [4]. There are a few different phrases that have been used to characterize addiction to smartphones. Some of these terms include "smartphone overuse," "mobile phone addiction," "problematic mobile phone use", "addiction proneness", and "excessive use of smartphones." The addiction to smartphones has been classified as a behaviour addiction in recent research, which studies the phenomenon of smartphone addiction. The defining characteristic of addiction is an abnormally high dependency on a certain substance or activity, which leads to frequent engagement in behaviours that are not desirable. A significant connection exists between addiction and the tendency of consumers to engage in excessive consumption and activities related to smartphones [5]. For instance, the amount of time spent using smartphones and social media on a daily basis was associated with smartphone addiction. Users of smartphones run the risk of developing an addiction to checking their devices constantly due to the quick satisfaction that smartphones provide via social media, entertainment, and information access [6].

Smartphones are useful for doing many transactions in everyday life [7]. Over time, mobile phone use has expanded rapidly. Smartphone users in the US spent 1.5 hours per day on social media in 2012 and 3.5 hours in 2017. Statistics from the OECD show that 14-24-year-olds spend 4.5 hours a day online. When global internet use rates were considered, adolescents and young adults spent the most time online [8]. Adolescents who use cell phones excessively may face a range of issues, including physical health issues like poor eyesight and bone deformity as well as psychological issues like worry and sadness that may damage relationships with others [9]. Excessive smartphone usage by college students has been linked to detrimental effects on academic performance, psychological health, and physical health, according to studies [10]. Smart phone addiction has been shown to be consistently associated with both physical and mental health symptoms [11]. These symptoms include anxiety, sadness, musculoskeletal issues [12], and sleeplessness [13]. Investigating the mechanism of adolescent smartphone addiction is crucial for preserving the physical and mental well-being of these individuals [14]. This will lower the prevalence of smartphone dependence, boost participation in recreational sports, and enhance physical fitness.

In contrast, the majority of prior research have shown that excessive usage of smartphones may have a variety of adverse effects on both the physical and psychological aspects of a person's life. These adverse effects include sleep deprivation, anxiety, stress, poor self-esteem, low satisfaction with life and depression [15]. As an example, teenagers who are actively involved in the usage of social media and smartphones are more likely to suffer high rates of despondency, suicidal thoughts, and attempts at suicide [16]. Additionally, those who engage in problematic smartphone usage are more likely to be engaged in potentially hazardous circumstances (for example, texting while driving) and to use their smartphones in unsuitable social and educational contexts (for example, when attending meetings, going to social dinners, or attending classes) [17].

A rise in the use of smart phones leads to a decrease in physical activity and a negative influence on self-esteem among teenagers. The purpose of this research is to investigate the mechanisms by which smartphone addiction affects DAS (depression, anxiety, and stress) sleep quality among adolescents. Specifically with regard to the mental health of adolescents, the results will contribute to a better understanding of the sociopsychological effects of smartphone addiction. Empirical evidence for interventions and the creation of policy is provided by the outcomes. As an example, schools and communities might encourage participation in leisure activities that include physical activity in order to assist teenagers in reducing their use of smartphones, so enhancing their mental health.

Literature review

This cross-sectional research aims to investigate the link between smartphone addiction and mental health difficulties among teenagers. The research found a substantial link (p<0.001) between smartphone addiction and mental health issues in teenagers, with 72.1% suffering addiction and 26.9% having abnormal mental health. These results highlight the need of raising awareness about the detrimental effects of excessive smartphone usage on teenage mental health. Guidance and counselling services in schools are crucial in tackling this problem. To improve generalizability, future research should use longitudinal designs and different populations to study causal links [18].

This research examined how loneliness mediates and leisure physical activity moderates the association between smartphone addiction and adolescent health. A study of 1271 Chinese university students used the PAPS Health and Fitness Scale, Smartphone Addiction Scale, and Leisure Time Exercise Scale. Smartphone addiction harms teens. Leisure physical activity moderates this association, whereas loneliness mediators it. Low levels of physical activity augment the detrimental effect of loneliness on health (b simple = −0.21, p<0.001), whereas high levels minimize it (b simple = −0.49, p<0.001). These findings have practical applications for minimizing smartphone addiction and theoretical support for encouraging healthy behaviour in teenagers [19].

This research examined smartphone addiction among Malaysian teenagers and its causes. Teens from 15 primary care clinics nationwide participated in this cross-sectional research. Participants completed the Malaysian short version of the Smartphone addiction scale (SAS-M-SV) to measure their smartphone use. Teen smartphone addiction factors were determined using multiple logistic regression. In the research, 49.6% of 921 adolescents were male (N=457). Adolescents were 16.4 2.4 years old on average. Based on ethnicity, 74.6% were Malay, 7.3% Chinese, 4.7% Indian, and 13.4% other. Smartphone addiction was 37.1% (342/921), men 37.4% and women 36.9% [20].

This research aimed to determine the frequency of smartphone addiction among Rhode Island youth and its link to mental disorders. The 2022 Rhode Island Young Adult Survey assessed smartphone addiction, sadness, anxiety, and suicidal thoughts. Age, sex/gender minority status, race/ethnicity, and socioeconomic position were covariates. Smartphone addiction is common among Rhode Island's young people, perhaps linked to sadness, anxiety, and suicidal thoughts. Heterosexual cis-males may be especially susceptible. Consider screening programs and treatments to limit smartphone usage among young people, especially young males [21].

Smartphones have made our lives simpler and are essential, but excessive usage may lead to “smartphone addiction” (SA). SA is becoming a global health problem; especially among youth. Few studies have examined SA's effects on young people, especially in poor nations like Bangladesh. Another cross-sectional research attempts to fill this gap. According to the study, 61.4% of young people were smartphone addicts. Logistic regression research identified masculinity, age ≤25, unemployment, and big family size (≥8) as significant predictors of SA. Smartphone addicts are less active, have sleeplessness, are overweight or obese, and use their phones while driving, walking, and eating. In addition, SA patients had higher physical and mental health issues. This research has major policy consequences and suggests a SA community awareness campaign to minimize SA as a society [22].

The purpose of this research is to find out how common smartphone addiction is among first-year medical students and to examine the relationships it has with identity as a professional, mental health, and personal characteristics.

According to this cross-sectional research, Chinese first-year medical students often suffer from smartphone addiction. Addiction to smartphones was prevalent among the first-year medical students questioned. The results suggest that educational initiatives designed to improve the mental well-being and sense of self among first-year medical students also contribute to a decrease in smartphone addiction in this demographic [23].

This research explored the incidence of smartphone addiction in depressed individuals and its relationship to depression severity. The psychiatry department of University Malaya Medical Centre in Kuala Lumpur, Malaysia, did cross-sectional research on 140 major depressive disorder patients. The SAS measured smartphone addiction. Clinicians used the Montgomery-Asberg Depression Rating Scale to measure depression severity. Smartphone addiction prevalence was 58.6% (n = 82). Participants who spent more time on their cell phones had a greater risk for the "overuse" subscale ($p < 0.01$), but smartphone addiction was not linked to depression severity. This study shows the need for greater research in this area [24].

To study smartphone addiction, nomophobia, and social anxiety. Translation, try-out, and main study comprised the study. Smartphone addiction significantly predicts social anxiety ($\beta = .197$, $p < .001$) and nomophobia ($\beta = .58$, $p < .001$). Smartphone addiction was 13% among male and 13% among female students, whereas nomophobia was 15% and 11%, respectively. Others had considerable social anxiety: 15% men and 11% women. Nomophobia and social anxiety are strongly linked to smartphone addiction. Both men and women have it. Female pupils were nomophobic. However, men had significant social anxiety ratings [25].

This research examined smartphone addiction in Filipino teenagers and its effects on health-related quality of life. This cross-sectional research used descriptive and hierarchical linear multiple regression analyses on Google forms data from 1,447 Filipino junior and senior high school students (males, N=580; females, N=867). This research suggests Filipino teenagers are highly addicted to smartphones. This requires parents, community educators, and counsellors to be aware of the problem and implement community- and school-based intervention programs to reduce smartphone addiction and its effect on student HRQoL [26].

This research looked at how USM medical students' psychological well-being and neuroticism related to smartphone addiction. In a public medical school, a cross-sectional study of medical students was conducted. The relationship between smartphone addiction and neuroticism and psychological discomfort was investigated using Spearman correlation. In order to look at the connection aspects of smartphone addiction, simple linear regression was used. According to this research, there is a significant risk of smartphone addiction among medical students, especially among male students. The most susceptible demographic for psychological issues resulting from smartphone addiction is medical students who exhibit neurotic personality traits [27].

Cross-sectional research was conducted utilizing easy sampling and unpaired categorical data for subject selection. Self-administered Smartphone Addiction Scale Short Version (SAS-SV) and Strength and Difficulties Questionnaire (SDQ) were used to examine individuals. Smartphone users were divided into low- and high-level. The data was examined using chi-square test. Among 206 participants, 178 satisfied inclusion criteria, with 44.9% (n=80) and 55.1% (n=98) experiencing high- and low-level smartphone addiction. Based on SDQ, 60.7, 21.9, and 17.4% of mental and emotional disorders were classified as normal, borderline, or abnormal. Those with high-level smartphone addiction presented with mental and emotional issues (1.425 prevalence ratio, CI95% 1.141-1.779). Conclusion: Smartphone addiction is linked to mental emotional issues in early adolescents [28].

Research gap

The research that was examined sheds light on a number of different elements of smartphone addiction among teenagers, including its correlations with mental health problems such as depression, anxiety, and stress (DAS), the quality of sleep, the amount of physical activity, and self-esteem. In spite of the fact that these studies provide useful insights into the incidence and effect of smartphone addiction, they often concentrate on certain demographics, such as college students or specific locations, and utilize cross-sectional research methodologies. This results in a lack of comprehension of the more comprehensive causal links that exist between addiction to smartphones and the impacts that it has on the mental health and well-being of teenagers. A further limitation is that there is a dearth of research that makes use of Structural Equation Modelling (SEM) to conduct an all-encompassing analysis of these variables within a unified framework. The purpose of our research is to fill this gap by investigating the prevalence of smartphone addiction and its impact on DAS, sleep quality, physical activity, smartphone usage, and self-esteem among a diverse population of adolescents. We will use structural equation modelling (SEM) analysis to gain a better understanding of the interconnectedness and causal pathways of these factors.

Methodology

Research Design

For the purpose of this study project, the structural equation modeling (SEM) method was used to evaluate the prevalence of smartphone addiction and mental health among adolescents. This research was to examine the smartphone addiction and its dependent variables, which include DAS (depression, anxiety, and stress), sleep quality, low levels of physical activity, usage of smart phones, and self-esteem among adolescents.

Random Sampling Technique

The method of picking samples from a population in such a way that each and every potential participant has an equal chance of being selected is referred to as random sampling. In the present study random sampling technique was used to select the samples.

Data Collection

The study Prevalence of Smartphone addiction and mental health among teenagers was conducted using a quantitative methodology. To gather information on the opinions and experiences of participants about smartphone addiction and its impact on mental health, organized questionnaires were sent to them. Smartphone addiction scale -short version with 10 items and DASS-21 questionnaire were used. Included in

the data collection and quantified for analysis were responses to several measures of smart phone addiction related to mental health difficulties such as depression, anxiety, stress, poor sleep quality, decreased physical activity, and low self-esteem. To examine any relationships and interactions between the variables, the data was analyzed using structural equation modeling.

Inclusion criteria

For this study, we employed a sample size of 520 respondents, and the inclusion criteria were that applicants had to be between the ages of 11 and 20 and that they had to be interested in responding to the survey.

Exclusion criteria

Respondents who are less than 11 years old, those who are older than 20 years old, and those who are unwilling to offer a response are not included in the sample size of 520.

Tools and Techniques for Data Analysis

Tools: In this study SPSS (Statistical Package for the Social Sciences) and AMOS (Analysis of Moment Structures) tool was utilized for Data Analysis

Techniques: Structural equation modelling (SEM) was the approach that was used in this research to investigate the connections between addiction to smartphones and a variety of outcomes, including but not limited to depression, anxiety, stress, sleep quality, physical activity, smartphone usage, and self-esteem among teenagers. There were standardized questionnaires that were used to gather the data. These questionnaires had questions that measured each construct, such as the SPA1-SPA6 for smartphone addiction and the DAS1-DAS6 for depression, anxiety, and stress, among other dimensions. For the purpose of determining the strength and significance of these associations, regression weights and model fit indices (such as CMIN/DF, RMR, GFI, CFI, and RMSEA) were computed.

Result

- **H_1:** Higher levels of smartphone addiction relationship with higher levels of DAS (Depression, Anxiety, Stress).

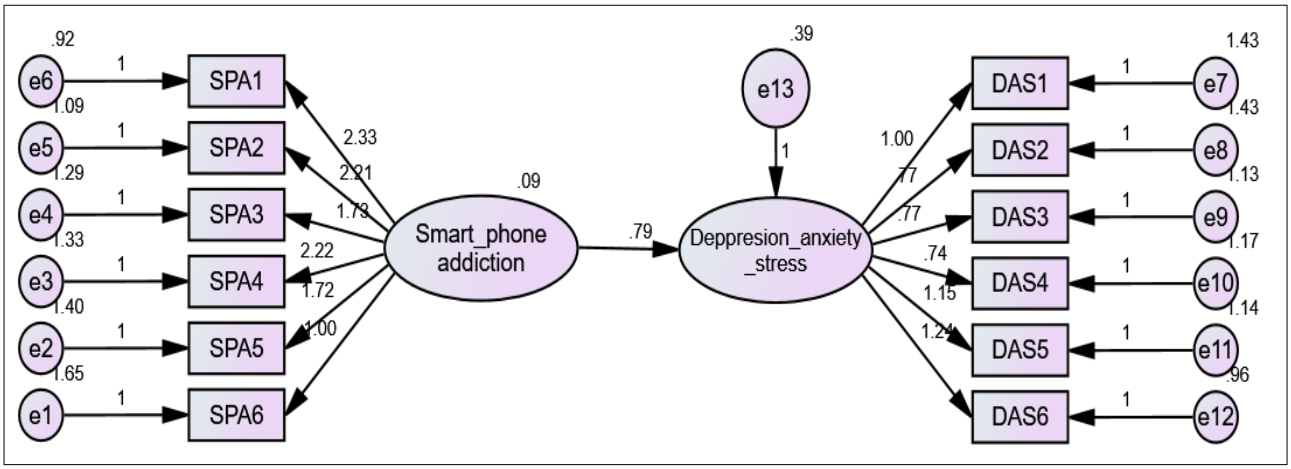

Fig 1: Show Smart Phone Addition and Depression anxiety stress

Table 1: Regression Weights: (Group number 1 - Default model)

PATH			Standardized Estimates	Unstandardized Estimates	S.E.	C.R.	P
Depression anxiety stress	<---	Smart phone addiction	.309	.688	.271	2.538	.011
SPA6	<---	Smart phone addiction	.197	1.000			
SPA5	<---	Smart phone addiction	.346	1.668	.567	2.941	.003
SPA4	<---	Smart phone addiction	.472	2.367	.761	3.110	.002
SPA3	<---	Smart phone addiction	.369	1.742	.584	2.984	.003
SPA2	<---	Smart phone addiction	.482	2.318	.743	3.117	.002
SPA1	<---	Smart phone addiction	.476	2.192	.704	3.113	.002
DAS1	<---	Depression anxiety stress	.424	1.000			
DAS2	<---	Depression anxiety stress	.330	.727	.146	4.990	***
DAS3	<---	Depression anxiety stress	.439	.925	.156	5.917	***
DAS4	<---	Depression anxiety stress	.451	.856	.143	5.994	***
DAS5	<---	Depression anxiety stress	.582	1.344	.203	6.631	***
DAS6	<---	Depression anxiety stress	.576	1.246	.188	6.612	***

The regression weights for Group 1's default model, which looks at the connections between smartphone addiction and stress, anxiety, and depression, are shown in Table-1. Standardized and unstandardized estimates, standard errors (S.E.), critical ratios (C.R.), and p-values are all included in the table. Numerous measures of stress, anxiety, and depression are strongly predicted by smartphone addiction (p-values <0.05). Standardized estimates range from 0.197 to 0.482, whereas unstandardized estimates range from 0.688 to 2.367. When it comes to stress, anxiety, and depression, the majority of the indicators have significant coefficients (p-values indicated with $p<.001$), showing strong relationships. DAS5 and DAS6 in particular, which have the highest critical ratios and significance levels, have

unstandardized estimates of 1.344 and 1.246, respectively. With 53 degrees of freedom (df) and a chi-square value (χ^2) of 83.694, together with a CMIN/DF ratio of 1.579, Table-2 displays a high model fit. Values below 2 are often considered adequate. Although a.005 p-value indicates statistical significance, a lower p-value may indicate areas where the model fits the data better. It indicates a very good fit (.974) because the Goodness of Fit Index (GFI) is close to 1. Despite being above the.80 threshold, the Relative Fit Index (RFI) of.802 indicates a moderate fit. The.935 Incremental Fit Index (IFI) and the.957 Normed Fit Index (NFI) both indicate a fit that is close to 1. The Comparative Fit Index (CFI) of.933, which shows that the model fits well, supports this even more. The RMR of.078 and the RMSEA of.033, which measure the root mean square error of approximation, are both within acceptable ranges, indicating a decent fit. An RMSEA of less than.05 suggests that the model fits the degrees of freedom closely. These indices suggest that the model generally matches the data quite well.

Table 2: Model Fit Summary

Variable	Value
Chi-square value(χ^2)	83.694
Degrees of freedom (df)	53
CMIN/DF	1.579
P value	.005
GFI	.974
RFI	.802
NFI	.957
IFI	.935
CFI	.933
RMR	.078
RMSEA	.033

- **H_2:** Higher levels of smartphone addiction association with Lower sleep quality.

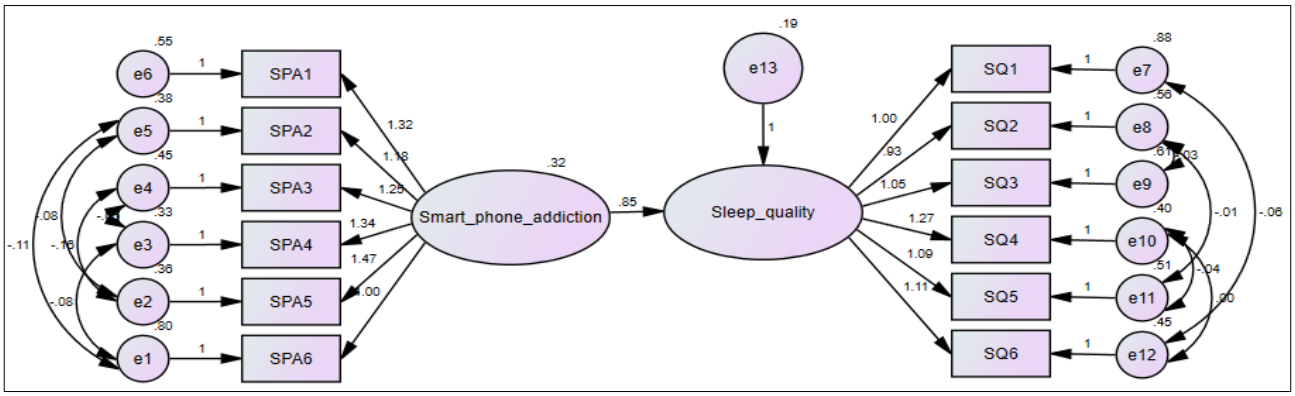

Fig 2: Show Smart Phone Addition and Sleep quality

Table 3: Regression Weights (Group number 1-Default model)

PATH			Standardized Estimates	Unstandardized Estimate	S.E.	C.R.	P
Sleep quality	<---	Smart phone addiction	.740	.846	.094	8.951	***
SPA6	<---	Smart phone addiction	.536	1.000			
SPA5	<---	Smart phone addiction	.810	1.468	.124	11.858	***
SPA4	<---	Smart phone addiction	.798	1.343	.117	11.512	***
SPA3	<---	Smart phone addiction	.727	1.249	.112	11.114	***
SPA2	<---	Smart phone addiction	.735	1.179	.110	10.737	***
SPA1	<---	Smart phone addiction	.711	1.321	.115	11.466	***
SQ1	<---	Sleep quality	.568	1.000			
SQ2	<---	Sleep quality	.628	.929	.087	10.708	***
SQ3	<---	Sleep quality	.659	1.050	.094	11.233	***
SQ4	<---	Sleep quality	.794	1.269	.104	12.203	***
SQ5	<---	Sleep quality	.703	1.086	.096	11.369	***
SQ6	<---	Sleep quality	.733	1.114	.097	11.442	***

The default model's regression weights are shown in Table-3, which also shows the connections between smartphone addiction and sleep quality. The impact of smartphone addiction on sleep quality is estimated to be 0.740 on a standardized basis, 0.846 on an unstandardized basis, 0.094 on a standard error basis, and 8.951 on a critical ratio basis. All of these estimates are significant at the $p<0.001$ level. Strong positive correlations are seen between the individual smartphone addiction items (SPA1 through SPA6), with critical ratios all above 10.737 and standardized estimates ranging from 0.536 to 0.810. Comparably, the sleep quality measures (SQ1-SQ6) show standardized estimates ranging from 0.568 to 0.794, with all critical ratios exceeding 10.708. This confirms the substantial correlation between decreased sleep quality and smartphone addiction.

Table 4: Model Fit Summary

Variable	Value
Chi-square value(χ^2)	128.269
Degrees of freedom (df)	43
CMIN/DF	2.983
P value	.000
GFI	.974
RFI	.926
NFI	.952
IFI	.967
CFI	.967
RMR	.046
RMSEA	.062

The summary of the model fit Key indicators for assessing a statistical model's goodness of fit are shown in Table-4. With 43 degrees of freedom, the chi-square value (χ^2) is 128.269, indicating the discrepancy between the actual and predicted data, while the CMIN/DF ratio of 2.983 indicates a good match. The null hypothesis of a perfect fit is rejected by the statistical significance shown by the p-value of.000. The Goodness of Fit Index (GFI), which measures how well the model fits the data, is high at.974. Additional indices that support a strong match are the Comparative match Index (CFI) of.967, the Incremental Fit Index (IFI) of.952, the Normed Fit Index (NFI) of.952, and the Relative Fit Index (RFI) of.926. The model appropriately represents the data, as evidenced by the Root Mean Square Residual (RMR) of.046 and the Root Mean Square Error of Approximation (RMSEA) of.062, both falling within reasonable limits.

- **H3**: Higher levels of smartphone addiction relationship with Lower physical activity.

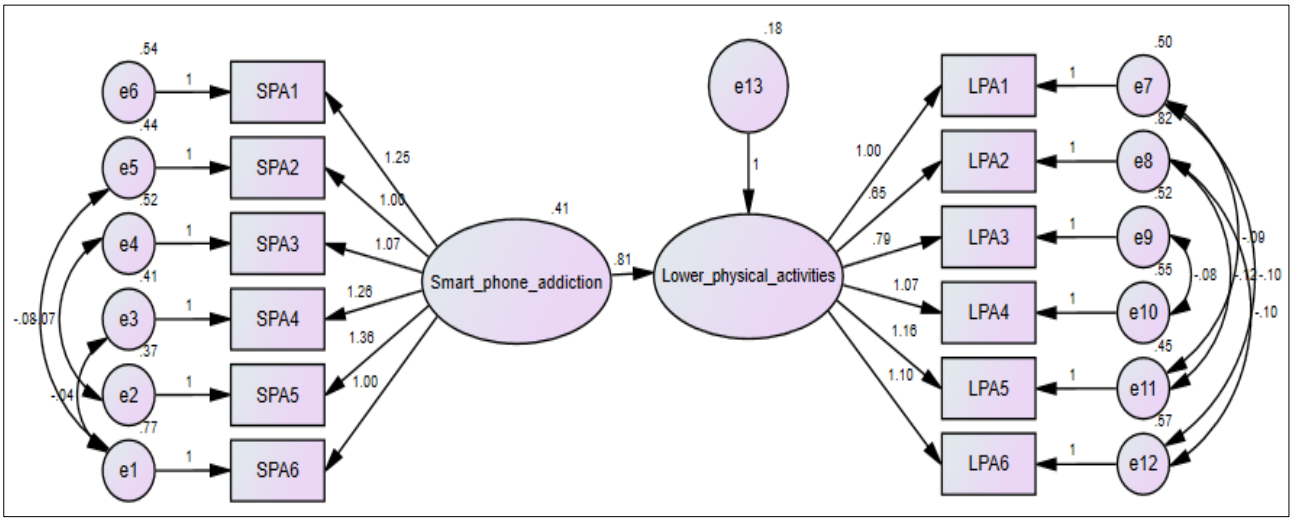

Fig 3: Show Smart Phone Addition and Lower physical activieties

Table 5: Regression Weights: (Group number 1-Default model)

Path			Standardized Estimates	Unstandardized Estimate	S.E.	C.R.	P
Lower physical activities	<---	Smart phone addiction	.772	.809	.076	10.604	***
SPA6	<---	Smart phone addiction	.589	1.000			
SPA5	<---	Smart phone addiction	.821	1.364	.102	13.341	***
SPA4	<---	Smart phone addiction	.786	1.265	.097	12.997	***
SPA3	<---	Smart phone addiction	.689	1.071	.090	11.926	***
SPA2	<---	Smart phone addiction	.694	.999	.086	11.571	***
SPA1	<---	Smart phone addiction	.737	1.252	.099	12.694	***
LPA1	<---	Lower physical activities	.687	1.000			
LPA2	<---	Lower physical activities	.437	.655	.076	8.584	***
LPA3	<---	Lower physical activities	.591	.788	.069	11.416	***
LPA4	<---	Lower physical activities	.694	1.069	.082	12.995	***
LPA5	<---	Lower physical activities	.757	1.163	.086	13.539	***
LPA6	<---	Lower physical activities	.701	1.103	.087	12.653	***

Table-5 shows the regression weights for the default model, which looks at the connection between a decrease in physical activity and smartphone addiction. The unstandardized estimate is 0.809 (S.E. = 0.076, C.R. = 10.604, $p<0.001$), whereas the standardized estimate is 0.772, demonstrating a strong positive connection. With standardized estimates ranging from 0.589 to 0.821 and critical ratios (C.R.) considerably over the significance threshold ($p<0.001$), several measures of smartphone addiction (SPA1 to SPA6) exhibit substantial positive relationships with smartphone addiction. With normalized estimates ranging from 0.437 to 0.757 and substantial critical ratios (C.R. ranging from 8.584 to 13.539, $p<0.001$), the markers for lower physical activities (LPA1 to LPA6) are also highly correlated with lower physical activities. All of these findings point to a clear correlation between decreased levels of physical activity and rising smartphone addiction.

Table 6: Model Fit Summary

Variable	Value
Chi-square value(χ^2)	131.843
Degrees of freedom (df)	45
CMIN/DF	2.930
P value	.000
GFI	.958
RFI	.924
NFI	.948
IFI	.965
CFI	.965
RMR	.042
RMSEA	.061

A chi-square value (χ^2) of 131.843 and 45 degrees of freedom are also included in Table-6 model fit summary, along with a CMIN/DF ratio of 2.930, indicating a satisfactory model fit. The very large p-value (.000) offers support for the model's fit. The appropriateness of the model

is evidenced by its 0.958 Goodness-of-Fit Index (GFI). The Relative fit Index (RFI) of 0.924 and the Normed Fit Index (NFI) of 0.948 indicate a decent fit. With an Incremental Match Index (IFI) and a Comparative Fit Index (CFI) of 0.965, the findings show a satisfactory match. The Root Mean Square Residual (RMR) of 0.042 and the Root Mean Square Error of Approximation (RMSEA) of 0.061, both of which are within acceptable boundaries, provide as further evidence of the model's durability.

- **H_4**: Higher levels of smartphone addiction association with increased smart phone usage.

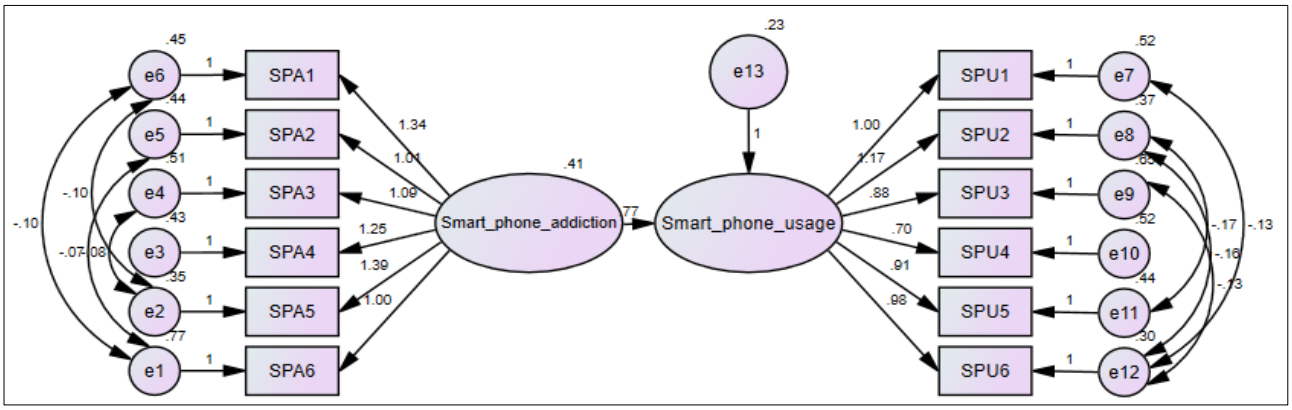

Fig 4: Show Smart Phone Addition and Smart phone usage

Table 7: Regression Weights: (Group number 1 - Default model)

PATH			Standardized Estimates	Unstandardized Estimate	S.E.	C.R.	P
Smart phone usage	<---	Smart phone addiction	.712	.772	.074	10.416	***
SPA6	<---	Smart phone addiction	.587	1.000			
SPA5	<---	Smart phone addiction	.831	1.388	.104	13.286	***
SPA4	<---	Smart phone addiction	.771	1.246	.095	13.111	***
SPA3	<---	Smart phone addiction	.695	1.086	.090	12.028	***
SPA2	<---	Smart phone addiction	.696	1.007	.086	11.762	***
SPA1	<---	Smart phone addiction	.787	1.342	.109	12.354	***
SPU1	<---	Smart phone usage	.691	1.000			
SPU2	<---	Smart phone usage	.797	1.170	.079	14.786	***
SPU3	<---	Smart phone usage	.601	.881	.071	12.445	***
SPU4	<---	Smart phone usage	.555	.696	.059	11.819	***
SPU5	<---	Smart phone usage	.687	.906	.067	13.592	***
SPU6	<---	Smart phone usage	.776	.978	.074	13.183	***

The structural equation model's regression weights are shown in Table-7, which also shows the correlations between smartphone use and addiction and the corresponding metrics. The strength of these correlations is shown by the standardized and unstandardized estimations. Interestingly, an unstandardized estimate of.772 (S.E. =.074, C.R. = 10.416, p<.001) and a standardized estimate of.712 indicate that smartphone addiction highly predicts smartphone use. Strong associations are shown by the critical ratios (C.R.) of indicators SPA1 through SPA6, which are considerably over the significance level and have standardized estimates ranging from.587 to.831. These indicators all significantly load onto the latent construct of smartphone addiction. In a similar vein, indicators SPU1 through SPU6 significantly influence smartphone use; their high C.R. values and standardized estimates, which range from.555 to.797, confirm the model's resilience in capturing the concepts of smartphone addiction and usage.

The model fit summary, shown in Table-8, shows how well the model represents the data. With 45 degrees of freedom and a Chi-square value (χ2) of 132.989, the p-value of.000 indicates a substantial match between the observed data and the model. A satisfactory match is indicated by the CMIN/DF ratio of 2.955, which is less than the generally accepted criterion of 3. This is further supported by fit indices, which all surpass the advised value of.90. The Goodness-of-Fit Index (GFI) is.958, the Relative Fit Index (RFI) is.927, the Normed Fit Index (NFI) is.950,

Table 8: Model Fit Summary

Variable	Value
Chi-square value(χ^2)	132.989
Degrees of freedom (df)	45
CMIN/DF	2.955
P value	.000
GFI	.958
RFI	.927
NFI	.950
IFI	.966
CFI	.966
RMR	.041
RMSEA	.061

the Incremental Fit Index (IFI) is.966, and the Comparative Fit Index (CFI) is.966. Acceptable model fit is suggested by the Root Mean Square Residual (RMR) of.041 and the Root Mean Square Error of Approximation (RMSEA) of.061. These figures show that the model does a good job of fitting the data overall.

- **H_5:** Hypothesis 5: Higher levels of smartphone addiction are negatively associated with self-esteem.

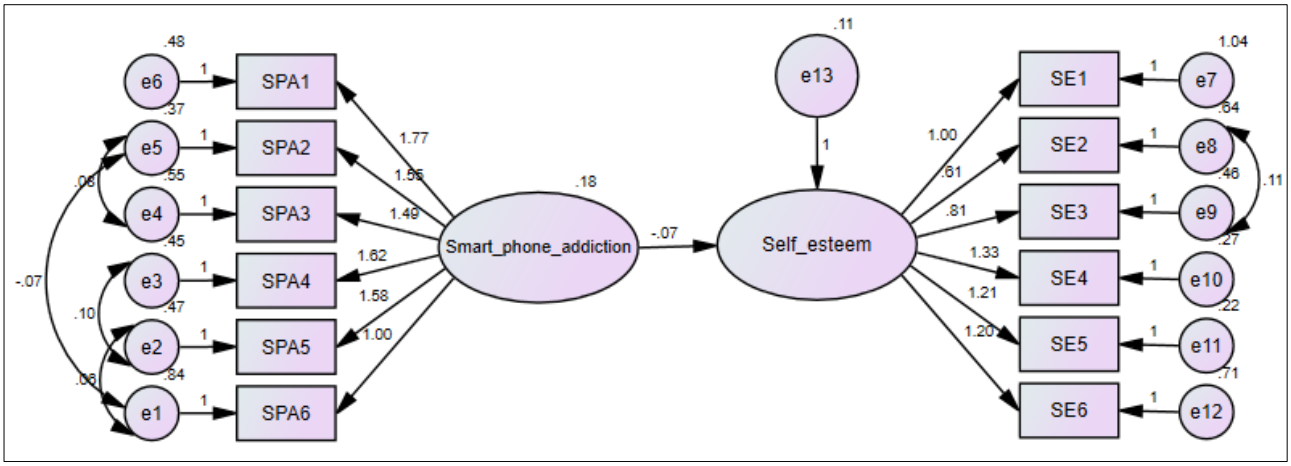

Fig 5: Show Smart Phone Addition and Self Esteem

Table 9: Regression Weights: (Group number 1-Default model)

PATH			Standardized estimates	Unstandardized Estimate	S.E.	C.R.	P
Self esteem	<---	Smart phone addiction	-.087	-.068	.048	-1.405	.160
SPA6	<---	Smart phone addiction	.420	1.000			
SPA5	<---	Smart phone addiction	.699	1.585	.187	8.481	***
SPA4	<---	Smart phone addiction	.715	1.621	.199	8.129	***
SPA3	<---	Smart phone addiction	.650	1.489	.189	7.877	***
SPA2	<---	Smart phone addiction	.735	1.549	.195	7.950	***
SPA1	<---	Smart phone addiction	.737	1.771	.215	8.241	***
SE1	<---	Self esteem	.308	1.000			
SE2	<---	Self esteem	.243	.610	.170	3.594	***
SE3	<---	Self esteem	.368	.814	.180	4.524	***
SE4	<---	Self esteem	.646	1.333	.253	5.280	***
SE5	<---	Self esteem	.648	1.209	.229	5.280	***
SE6	<---	Self esteem	.428	1.205	.250	4.812	***

The table displays the regression weights together with the corresponding path estimates for a model that looks at the connection between smartphone addiction and self-esteem. The association between smartphone addiction and self-esteem is not statistically significant (p =.160), despite the fact that the standardized estimate of this route is negative (-.087). All routes (SPA1 to SPA6) for the smartphone addiction (SPA) indicators exhibit strong positive standardized estimates with p-values less than.001 (shown by ***) and critical ratios (C.R.) that are highly significant, ranging from.420 to.737. Similar to this, there are substantial positive associations shown by the self-esteem (SE) indicators (SE1 to SE6), with critical ratios between 3.594 and 5.280 and standardized estimates ranging from.243 to.648 that are all significant at p<.001. These findings imply that while there is no substantial direct relationship between smartphone addiction and self-esteem, there is a strong and significant relationship between the indicators for both constructs within the measures used. The Model Fit Summary, shown in Table-10, illustrates the model's suitability and resilience. With 48 degrees of freedom and a Chi-square value (χ2) of 89.646, the CMIN/DF ratio of 1.868 indicates an excellent fit in relation to the degrees of freedom.

The statistical significance is shown by the P value of.000. The results indicate a good model fit. The Goodness of Fit Index (GFI) is.972, the Relative Fit Index (RFI) is.915, and the Normed Fit Index (NFI) is.938. The model's good fit is further supported by the Incremental Fit Index (IFI) and Comparative Fit Index (CFI), both of which are at.970. Furthermore, the model's correctness and dependability in describing the data are confirmed by the Root Mean Square Residual (RMR) of.040 and the Root Mean Square Error of Approximation (RMSEA) of. 041, both being within acceptable bounds.

Table 10: Model Fit Summary

Variable	Value
Chi-square value (χ^2)	89.646
Degrees of freedom (DF)	48
CMIN/DF	1.868
P value	.000
GFI	.972
RFI	.915
NFI	.938
IFI	.970
CFI	.970
RMR	.040
RMSEA	.041

Discussion

While the studies may have varying goals and methodologies, they all investigate the intricate relationships between smartphone use, smartphone addiction, and the resulting mental health implications. Our study investigates the correlation between smartphone addiction and elevated levels of stress, anxiety, and depression, as well as worse sleep quality and less physical activity. Conversely, previous studies on teenagers highlight a significant and favourable correlation between several factors such as loneliness and overall life satisfaction. Unlike previous research, our study did not reveal a significant association between self-esteem and smartphone addiction. Our study

emphasizes the adverse impacts of smartphone addiction on both mental and physical well-being, which differs from prior studies. However, there are varying results on the influence of smartphone use on life satisfaction and self-esteem. Each of these sources emphasizes the need of managing smartphone use to mitigate adverse effects on physical and mental well-being, suggesting the need for targeted interventions.

The present research discovered a significant link between excessive smartphone use and the occurrence of depression, anxiety, and stress. This finding contradicts the findings of a prior literature study, which did not uncover any association between owning a smartphone and experiencing symptoms of depression. However, separate research discovered that levels of state anxiety, trait anxiety, and depression were elevated in the group of college students who excessively used smartphones compared to the group of students who used smartphones normally. These findings align with the results of the current study. The current research on depression and anxiety aligns closely with the results of prior investigations.

Research performed on undergraduate students indicates that there is a direct relationship between smartphone use and life satisfaction (SWL), with more smartphone usage being associated with higher levels of life satisfaction. Additionally, there is an inverse relationship between smartphone usage and depression, anxiety, and stress (DAS), meaning that increased smartphone usage is linked to lower levels of sadness, anxiety, and stress.

However, research also indicates that smartphone addiction is a significant factor that does not impact subjective well-being but instead worsens symptoms of depression, anxiety, and stress. Based on this, it seems that although sporadic smartphone use has its benefits, excessive use leading to addiction is detrimental to mental well-being. The findings indicated that those in the high smartphone usage group had a greater prevalence of poor sleep quality compared to those in the low smartphone use group. This outcome might perhaps be attributed to sleep dysregulation. Prior research has indicated that exposure to electromagnetic fields in the evening can impact physiological factors such as sleep quality and the melatonin rhythm, likely by affecting the pineal gland. It can also lead to changes in cerebral blood flow and brain electrical activity. Additionally, prolonged use of electromagnetic fields has been associated with physical discomfort and headaches, which can have a detrimental effect on sleep. These processes discovered in technology users are likely to be responsible for sleep disorders in those who excessively use smartphones.

Utilizing a smartphone may enhance life satisfaction and reduce stress by facilitating social connectivity and providing access to information, so promoting overall wellness. However, when the use of smartphones becomes obsessive, it may exacerbate mental health disorders such as stress, anxiety, and depression. Additionally, it can have adverse effects on physical health by reducing physical activity and disrupting sleep patterns. This advanced understanding highlights the need of distinguishing between beneficial consumption and harmful addiction. In addition, our study's absence of a substantial correlation, in comparison to other research, between smartphone addiction and self-esteem suggests the potential influence of other variables on self-esteem or a more intricate and indirect relationship between smartphone addiction and self-esteem than previously assumed. To mitigate the adverse effects of addiction, it is crucial to use customized interventions that target both the quantity and quality of smartphone usage. These treatments should prioritize promoting good digital habits, engaging in offline activities, and fostering a supportive environment. In order to mitigate the detrimental consequences of smartphone addiction and improve the overall well-being of teenagers, it is crucial to tackle these issues via educational programs, parental oversight, and mental health support.

Conclusion

Examining the frequency of smartphone addiction in teenagers and its impact on mental health, sleep quality, physical activity, smartphone usage, and self-esteem are the main goals of this study. The findings show that higher degrees of smartphone addiction are significantly positively correlated with higher levels of stress, anxiety, and depression (DAS). High model fit indices and robust regression weights provide as evidence for this. Strong correlations between smartphone addiction and worse sleep quality are shown by high normalized estimates and significant p-values. The two are correlated, which explains why this is the case. High standardized estimates and significant critical ratios are linked to the phenomena of smartphone addiction, which the research also shows has a negative impact on physical activity. Furthermore, there is a strong positive association between increased smartphone usage and increased smartphone addiction, as seen by the relationship between the two. The measures for both domains are significantly related inside the model, although there is no statistically significant relationship between smartphone addiction and self-esteem. The model's overall fit, which indicates that the model is exceptionally valid and dependable, with all indices falling within acceptable parameters. According to these results, adolescents' mental and physical health are negatively impacted by excessive smartphone use, which emphasizes the need for programs designed to explicitly address these problems to be put in place.

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