Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

To Study the Prevalence of Overweight and Obesity by Assessing Body Mass Index (BMI) Among the Smartphone Users of School-Age Children and Adolescents: A Cross-Sectional Study in Malawa Region, Indoor MP

Mohd. Faheem Khan[1], Mohmmad Imran[2], Manila Jain[3*]

[1]Ph.D. Scholar, Department of Physiology, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore (M.P)

[2]Assistant Professor, Department of Biochemistry, Shri Ramkrishna Institute of Medical Sciences and Sanaka hospitals.

[3]Professor & Head, Department of Physiology, Index Medical College, Hospital and Research Centre, Malwanchal University, Indore (M.P).

Corresponding Author:
Dr. Manila Jain
Professor & Head
Department of Physiology
Index Medical College, Hospital and Research Centre
Malwanchal University, Indore (M.P).

(Received: 04 February 2024 Revised: 11 March 2024 Accepted: 08 April 2024)

KEYWORDS
Obesity, Lipid profile, Problematic smartphone use, Children, Adolescents

ABSTRACT:

Background: Body mass index (BMI) is one of the most commonly used indices to measure the weight status of an individual. Overweight children and adolescents have reached the dimensions of a global epidemic in recent years. Simultaneously, information and communication technology use has rapidly increased.

Aim: To find the prevalence of overweight and obesity by assessing body mass index (BMI) among the smartphone users of school-age children and adolescents in Malawa region, Indoor MP.

Methods: This cross-sectional study was conducted in the Department of Physiology, Index Medical College, Hospital and Research Centre Indore MP, India. The study participants from primary, higher secondary, and intermediate schools located in rural and urban areas of Madhya Pradesh; of either sex adolescents (10 to 19 years) of age group were enrolled in this study. Anthropometric parameters (age, height, weight, and BMI), physical inactivity, and lipid profile screening (such as total cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein, and very low-density lipoprotein) were recorded.

Results: Children with higher age, male sex, non-veg diet, father's employment, and higher socioeconomic status were significantly associated with obese and overweight children ($p<0.05$). Outdoor playing and playing every day were significantly higher in Normal BMI children ($p<0.05$). while indoor physical activity was significantly lower in obese, overweight, and underweight children ($p<0.05$). Total cholesterol, triglycerides, LDL, and VLDL were significantly higher in obese and overweight children ($p<0.05$). while HDL, outdoor, and indoor physical activity were significantly lower in obese and overweight children ($p<0.05$). BMI and Use of smartphones every day were positively significantly associated ($p<0.001$). Playing every day and lipid profile (total cholesterol, triglycerides,

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

and LDL) was positive and HDL was negative significantly associated with BMI and duration of use of smart Phone every ($p<0.001$

Conclusions: According to this study, there is a varied correlation between teenage obesity and using one or more forms of screen-based electronic devices for more than two hours a day and being overweight or obese. This study does, however, strongly suggest that longitudinal research be done in the future to validate our results and determine the pattern of connection with weight status.

Introduction:

The information technology era has seen the emergence of several new hazardous behaviors, including internet gaming, gambling, and sexual behaviors that have the potential to become obsessive.[1] In extreme cases, these behaviors may be regarded as behavioral or non-substance addictions since the people may feel unable to stop them without outside intervention.[2] One of the first types of information technology addiction to be studied was internet addiction. Based on an earlier study on internet addiction, the relatively novel idea of "smartphone addiction" (SA) has also been examined.[3] Because they provide constant internet access regardless of time or location, cell phones set themselves apart from typical Internet users on PCs or laptops. An Internet addiction condition or Internet overuse issue is the main cause of smartphone addiction.[4] Due to the growing prevalence of cell phones, most individuals now communicate mostly online—through social media and interactive texts—instead of in person.

Adolescence is a significant period (from ages 10 to 19) of human life with major formative encounters introducing the much-expected move from childhood to adulthood.[5] Since children and teens are considered to be among the primary predictors of future economic and societal growth, their welfare is of utmost importance to any nation. Adolescent obesity and overweight are becoming more commonplace worldwide, and this poses a grave risk to public health in both industrialized and developing nations.[6] Overweight and obesity are defined as abnormal or excessive fat buildup, which can hurt one's health since it is largely brought on by an imbalance between energy intake and expenditure.[7] The World Health Organisation (WHO) estimates that over 158 million children and adolescents worldwide were obese in 2020[7], with developing nations accounting for roughly 81% of these cases.[8]

However, several studies that have examined the impact of excessive use of electronic devices with screens (EMDs) on the risk of overweight and obesity in teenagers have mostly been conducted in industrialized as well as developing nations.[9,10,11] There is little information on the connection between EM usage and obesity in early adolescents in Bangladesh. Similarly, some research has examined the disparities in gender and teenage screen-based habits.[21,12] Sedentary conduct has been linked to rapid socioeconomic growth and growing urbanization in Bangladesh. Adolescents are currently interacting with technology at a very high rate, often through sedentary screen-based activities like watching television and using smartphones, as well as social networking sites like Facebook and Twitter.[13] Given that using many electronic screens at once has become common in India, a thorough analysis of the use of multiple EM may be able to provide us with a better understanding of the whole picture. Thus, the goal of this study was to assess the relationship between teenage smartphone use and overweight and obesity in Madhya Pradesh, India.

Material & Methods:

This cross-sectional study was conducted in the Department of Physiology, Index Medical College, Hospital and Research Centre Indore MP, India. After approval of the Institutional Ethical Committee. The study participants from primary, higher secondary, and intermediate schools located in rural and urban areas of Madhya Pradesh; of either sex adolescents (10 to 19 years) of age group were enrolled in this study. Subjects aged less than 10 years and more than 19 years, adolescents who do not use smartphones, Hereditary

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

Overweight, and Obesity and neurological disorders were excluded from the study.

The outcome of the study:

• Anthropometric parameters (age, height, weight, and BMI)
• Physical inactivity
• Lipid profile screening (such as Total Cholesterol, Triglycerides, High-Density Lipoprotein, Low-Density Lipoprotein, and Very Low-Density Lipoprotein).

Statistical Analysis

Data was analyzed using Statistical Package for Social Sciences, version 20.0 (SPSS Inc., Chicago, IL). Results for continuous variables were presented as mean ± standard deviation, whereas results for categorical variables were presented as frequency/number (percentage). The correlation between the duration of smartphone use, BMI, and lipid profile was evaluated by the Pearson correlation coefficient test. The level $P < 0.05$ was considered as the cutoff value or significance.

Observation & Results:

The table displays the findings of a survey conducted to assess BMI distribution based on the demographic and socioeconomic status of the participants. We noted that children with higher age, male sex, non-veg diet, father's employment, and higher socioeconomic status were significantly associated with obese and overweight children ($p<0.05$). While the mode of residence, family size, and smoking were significantly associated (>0.05).

Table No 1: Comparison of BMI with each demographic parameter

Variable		Obese (n=104)	Overweight (n=56)	Normal (n=144)	Underweight (n=96)	p-value
Age (Mean±SD)		16.2±2.3	17.8±1.8	16.3±2.0	14.2±2.6	**<0.001***
Gender	**Male**	58 (55.8%)	16 (28.6%)	59 (41.0%)	67 (69.8%)	**<0.001**[#]
	Female	46 (44.2%)	40 (71.4%)	85 (59.0%)	29 (30.2%)	
Mode of Residence	**Family**	62 (59.6%)	38 (67.9%)	82 (56.9%)	53 (55.2%)	0.714[#]
	Hostel	23 (22.1%)	10 (17.9%)	37 (25.7%)	28 (29.2%)	
	PG	19 (18.3%)	8 (14.3%)	25 (17.4%)	15 (15.6%)	
Father's Occupation	**Govt. Employee**	39 (37.5%)	22 (39.3%)	29 (20.1%)	13 (13.5%)	**<0.001**[#]
	Private Employee	42 (40.4%)	7 (12.5%)	65 (45.1%)	51 (53.1%)	
	Business	23 (22.1%)	26 (46.4%)	22 (15.3%)	15 (15.6%)	
	Farmer	0 (0.0%)	1 (1.8%)	28 (19.4%)	17 (17.7%)	
Family size	**Joint**	54 (51.9%)	37 (66.1%)	80 (55.6%)	43 (44.8%)	0.077[#]
	Nuclear	50 (48.1%)	19 (33.9%)	64 (44.4%)	53 (55.2%)	
Socio-economic	**High**	26 (25.0%)	9 (16.1%)	37 (25.7%)	36 (37.5%)	**0.004**[#]
	Middle	60 (57.7%)	24 (42.9%)	68 (47.2%)	36 (37.5%)	
	Low	18 (17.3%)	23 (41.1%)	39 (27.1%)	24 (25.0%)	
Smoking	**Yes**	11 (10.6%)	7 (12.5%)	16 (11.1%)	8 (8.3%)	0.855[#]
	No	93 (89.4%)	49 (87.5%)	128 (88.9%)	88 (91.7%)	

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

Diet	**Veg**	64 (61.5%)	35 (62.5%)	75 (52.1%)	70 (72.9%)	0.014#
	Non-veg	40 (38.5%)	21 (37.5%)	69 (47.9%)	26 (27.1%)	

***One Way ANOVA; #Chi Square test**

In this table, we compare the physical activity and children's use the smartphones each day in various states of obesity. We found that outdoor playing and playing every day were significantly higher in Normal BMI children ($p<0.05$). while indoor physical activity was significantly lower in obese, overweight, and underweight children ($p<0.05$). This study further noted that no significant child was using the smartphone each day (hr. /day) on the BMI of children ($p>0.05$).

Table No 2: Correlation of BMI with physical activity and child uses the smartphone each day

Variable		**Obese (n=104)**	**Overweight (n=56)**	**Normal (n=144)**	**Underweight (n=96)**	**p-value**
Physical activity (In Minute)	**Indoor**	22.7±13.5	31.7±17.8	33.7±15.7	16.5±9.4	**<0.001&***
	Outdoor	34.9±16.0	44.8±14.7	46.5±14.6	32.3±16.2	**<0.001***
Play every day (hr.)		1.9±0.8	2.3±0.7	1.9±0.7	1.6±0.7	**<0.001***
Sleep every day (hr.)		8.0±0.9	8.0±0.7	7.9±0.8	8.0±0.7	0.543*
The child uses the smartphone each day (hr./day)	**<2**	32 (30.8%)	24 (42.9%)	54 (37.5%)	34 (35.4%)	0.469#
	≥2	72 (69.2%)	32 (57.1%)	90 (62.5%)	62 (64.6%)	

***One Way ANOVA; #Chi Square test**

In this table, we compare the lipid profile in various states of obesity. We found that total cholesterol, triglycerides, LDL, and VLDL were significantly higher in obese and overweight children ($p<0.05$). while HDL, outdoor, and indoor physical activity were significantly lower in obese and overweight children ($p<0.05$).

Table No 3: Correlation of BMI with Lipid profile

Lipid profile	**Obese (n=104)**	**Overweight (n=56)**	**Normal (n=144)**	**Underweight (n=96)**	**p-value**
Total cholesterol	183.0±8.9	180.9±5.7	165.0±3.2	164.8±3.3	**<0.001**
Triglycerides	105.3±6.7	108.5±9.2	84.9±3.1	85.1±3.0	**<0.001**
HDL	42.1±1.4	42.0±1.4	50.1±3.1	49.5±2.6	**<0.001**
LDL	114.4±6.3	114.8±5.5	100.4±6.0	100.3±5.7	**<0.001**
VLDL	24.0±8.3	23.1±8.8	19.7±5.6	18.2±5.9	**<0.001**

***One Way ANOVA;**

In this study, we noted that BMI and the Use of smartphones every day were positively significantly associated ($p<0.001$). Playing every day and lipid profile (total cholesterol, triglycerides, and LDL) was positive and HDL was negative significantly associated with BMI and duration of use of smart Phone every ($p<0.001$). This study further noted that there was no significance in Sleeping time every day on BMI and duration of use of smart Phone every of children ($p>0.05$).

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

Table No 4: Association of BMI and children using a smartphone with physical Activity and lipid profile

	BMI		Use of smart Phone every day	
	r value	**p-value**	**r value**	**p-value**
BMI	1	--	0.245**	**<0.001**
Use of smart Phone every day	0.245**	**<0.001**	1	**--**
Play every day	0.169**	**0.001**	0.321**	**<0.001**
Sleep every day	0.045	0.371	0-.094	0.062
TC	0.790**	**<0.001**	0.191**	**<0.001**
TG	0.788**	**<0.001**	0.223**	**<0.001**
HDL	-0.765**	**<0.001**	-0.248**	**<0.001**
LDL	0.682**	**<0.001**	0.200**	**<0.001**
VLDL	0.352**	**<0.001**	0.049	0.328
**. Correlation is significant at the 0.01 level (2-tailed).				
*. Correlation is significant at the 0.05 level (2-tailed).				
r value=Pearson's Correlation Coefficients; p value= Significance level				

Discussion:

In the present study, the mean age of the studied subjects was 15.9 years, with a standard deviation of 2.5 years. The majority of the subjects of 19 years (21.3%) followed by 18 years (17.8%). Among those 50.0% were male and 50.0% were females. The mean weight (kg) of study participants was 57.1±10.8. The mean height (cm) was 158.0±7.7. The mean BMI (kg/m2) was 22.9±4.9. The majority (58.8%) lived with their families, followed by hostels (24.5%) and PG accommodation (16.8%).25.8% of fathers were government employees, 41.3% were private employees, 21.8% were involved in business, and 11.3% were farmers. 53.5% of families were joint families, while 46.5% were nuclear families. 27.0% of participants were classified as having a high socio-economic status, 47.0% had a middle socio-economic status, and 26.0% had a low socio-economic status. Our findings were to the findings of **Brodersen K et al**[14] who reported that there were 55.7% identified as female, 38.5% as male, and 5.7% as transgender, other, or preferred not to disclose their gender. Categories for ethnicity were adapted to represent the Indigenous (5%), Canadian (39.8%), and other (55.2%) populations. Youth were recruited from grades 9 (29.7%), 10 (20.4%), 11 (14.5%), and 12 (35.4%) and the average age was 16 years old. **Ma Z et al**[15] shows that of the 7506 members with complete data, 3732(49.7%) were male, and 3774(50.3%) were female. The mean age of participants was 12.43 years old. According to **Bhandari DJ et al**[16] a total of 496 adolescent students in the age group of 16–19 years participated in our study, having a mean age of 17.8 years ± 1.1. 58.5% were from urban areas and 46.2% of subjects' fathers were graduated or above. **Shuvo SD et al**[17] reported that of the 350 teenagers, 39.2% were females and 60.8% were guys. About 57% of the students studied in class nine, while 43.0% did so in class eight. In general, 62.4% of teenagers did not routinely engage in physical activity, and 51.7% of them had bad eating habits while using electronic media. In terms of parental education, the mothers and dads of respondents had doctorate degrees in 44.0% and 62.0% of cases, respectively, whilst the mothers and fathers of teenagers had only finished basic school in 13.2% and 10.9% of cases. About 78.0% of adolescents' mothers were housewives, 40.0% of adolescents' fathers were company owners, and roughly 4.0% of adolescents were day laborers. The teens' monthly household income fell between 20,001 and 30,000 BDT, or 39.0% and 37.0% of the total.

In our study, children with higher age, male sex, non-veg diet, father's employment, and higher socioeconomic status were significantly associated with obese and overweight children ($p<0.05$). While the mode of residence, family size, and smoking were significantly associated (>0.05). In the study by **Shuvo SD et al**[17] unhealthy eating practices when using electronic media were found to be strongly linked to obesity and overweight. Our results are consistent with earlier research conducted in other nations.[18,19] This could be because of prolonged sedentary behavior and the high energy intake might promote visceral fat in adolescents.[20]

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

Unhealthy eating habits like diets higher in fat, and the drink more sodas, and the fast food during electronic device use might lead to overconsumption among school adolescents.[21] In agreement with the previous experimental studies[22,23], **Shuvo SD et al**[17] discovered that among teenagers enrolled in secondary schools, physical activity had an inverse relationship with overweight and obesity. Recent research has clarified the connection between physical inactivity and bad eating habits, increased sedentary time, and excessive screen time in teenagers.[24,25]

Furthermore, movies about healthy diets and physically active video games may help overweight and obese teenagers with their body composition. These days, maintaining a healthy weight may be achieved by increasing regular physical activity, making eating healthful choices, and reducing recreational EM usage. The results of this study may also help support the implementation of adolescent health-based policies by parents and policymakers. [26]

In the present study, we found that total cholesterol, triglycerides, LDL, and VLDL were significantly higher in obese and overweight children ($p<0.05$). while HDL, outdoor, and indoor physical activity were significantly lower in obese and overweight children ($p<0.05$). Our findings were comparable to the findings of **Parkar MA et al**[27] who examined the impact of cell phone use on the physiologic and hematologic parameters of male medical students in Bijapur, Karnataka), using the serum lipid profile as a reference. The results showed that Group II, who had been using cell phones for more than four years, had significantly higher levels of total cholesterol, VLDL, LDL, and triglycerides than Group I, who had never used a cell phone.

The rise of serum triglycerides in group II may be due to a lack of activity of lipoprotein lipase, which breaks up triglycerides inside chylomicrons, releasing fatty acids in the process. Fatty acids can either be used by muscles as energy or be absorbed by the fat cells, where they are reincorporated into triglycerides that can be stored for further energy needs.[28] It can therefore postulated from this study that radiofrequency exposure was associated with a greater chance of becoming dyslipidemic.[29]

Research shows that problematic smartphone use is significantly related to loneliness[30], low self-esteem, and depression.[31] Poor mental health has also proven a risk factor for childhood obesity.[32] Additionally, a person's diet and daily routine are negatively impacted by smartphone reliance, which leads to overweight or obesity.[33] Additionally, academic stress contributes to addictive behaviors, like smartphone addiction.[34]

The association between problematic smartphone use and BMI may vary depending on sex and educational stage due to the notable disparities in physical activity, mental health, smartphone usage habits, and academic stress among various sex and educational stages.[31] While research has been done on the relationship between problematic smartphone usage and BMI, there hasn't been much done on the relationship between content-based problematic smartphone use and BMI in school-age children and adolescents.

Moreover, **Ma Z et al**[15] studies revealed that middle school students' academic stress was much lower than that of high school students. This may have lowered the likelihood that middle school students would engage in problematic smartphone use, as prior research has established a positive correlation between stress and smartphone addiction.[34] Problematic smartphone usage for entertainment among elementary and high school kids may lower physical activity levels (particularly outdoor physical activity) and increase sedentary time, which might lead to a rise in the obesity rate.

Furthermore, prior research has demonstrated that excessive smartphone usage can exacerbate mental health issues while also harming physical health (such as musculoskeletal issues and eyesight loss) (e.g., depression and anxiety)[35], maladjustments at school[36], compromised privacy, and cyberbullying.[37] Therefore, we should: (1). Increasing the number of physical education classes and sports facilities on campus can help decrease the excessive use of cell phones by encouraging children and teenagers to engage in outside activities and physical exercise. (2). Families should be encouraged to create and follow a Family Media Use Plan that specifies the kind and quantity of media that is suitable for each kid and also encourages them to receive the required amount of sleep, exercise, and study time. (3). Urge parents to have a conversation with their kids about the

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

idea of being a "good digital citizen" as well as the grave repercussions of cyberbullying or online harassment. (4). Encourage further study on the advantages and disadvantages of media and share the results with educators and families.[36]

Seaun R et al[38] also suggest that the effects of smartphone use on diet may vary depending on the contents that adolescents are exposed to while using smartphones. After controlling for the total amount of time spent using cell phones, the study found that teenagers who used them more often for non-educational (as opposed to educational) materials, such as gaming, SNS/forum, and messenger, consumed fewer fruits and vegetables overall. Similarly, a previous study showed that prolonged leisure time but not study-time Internet use was associated with less frequent intakes of fruits and vegetables[39], suggesting that the associations may be partially due to the contents that adolescents commonly access during their leisure time but not during study time.

According to **Kumar S et al**[40] poor quality of sleep was observed in 61% of study participants. Prolonged use of smartphones and exposure to smartphone screen light close to bedtime disrupt the circadian rhythm, leading to poor quality and quantity, fatigue, daytime sleepiness, and functional, behavioral, and social impairment.[41]

Limitations of the study

- Given the cross-sectional design of the study, it's difficult to clarify temporal relation and thus it should not be interpreted as causal.
- Our data also lack information on the time of day (e.g., day compared with night) and environmental settings (e.g., home compared with outdoor) of smartphone use, and thus further studies are required to clarify relations accounting for various factors that may influence food options and appetite.

Strengths of the study

The key strength of the study is that we utilized youth citizens' smartphones, to ethically and efficiently collect data about health outcomes and screen time behaviors. Furthermore, by concentrating on both individual smartphone behaviors (such as gaming and messaging) and total smartphone use, this study modified established self-reported questionnaires to further analyze behaviors specific to smartphone devices.

Conclusion

According to this study, there is a varied correlation between teenage obesity and using one or more forms of screen-based electronic devices for more than two hours a day and being overweight or obese. According to the study, viewing television was linked to an increased incidence of obesity and overweight in teenagers. The usage of smartphones, computers, and video games was also linked to overweight and obesity among teenagers, according to one study. The total cholesterol, triglycerides, LDL, and VLDL were significantly higher in obese and overweight children ($p<0.05$). while HDL, outdoor, and indoor physical activity were significantly lower in obese and overweight children ($p<0.05$). This study does, however, strongly suggest that longitudinal research be done in the future to validate our results and determine the pattern of connection with weight status. By implementing school-based intervention programs, teenagers and adolescents may use EM less frequently. In addition, parents have to take a proactive approach to minimize their kids' screen time and instead push them to participate in physical activities.

Reference

1 Karim, R.; Chaudhri, P. Behavioural Addictions: An Overview. J. Psychoact. Drugs 2012, 44, 5–17.

2 Grant, J.E.; Potenza, M.N.; Weinstein, A.; Gorelick, D.A. Introduction to behavioral addictions. Am. J. Drug Alcohol Abus. 2010, 36, 233–241.

3 Kwon, M.; Lee, J.-Y.; Won, W.-Y.; Park, J.-W.; Min, J.-A.; Hahn, C.; Gu, X.; Choi, J.-H.; Kim, D.-J. Development and Validation of a Smartphone Addiction Scale (SAS). PLoS ONE 2013, 8, e56936.

4 Montag, C.; Wegmann, E.; Sariyska, R.; Demetrovics, Z.; Brand, M. How to overcome taxonomical problems in the study of Internet use disorders and what to do with "smartphone addiction"? J. Behav. Addict. 2021, 9, 908–914.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

5 World Health Organization. (2021). Working for a brighter, healthier future: how WHO improves health and promotes well-being for the world's adolescents.

6 Wang Y, Lobstein TI. Worldwide trends in childhood overweight and obesity. International journal of pediatric obesity. 2006; 1(1):11–25.

7 Lobstein T, Brinsden H. Atlas of childhood obesity. World Obesity Federation. 2019; 1(October):213.

8 Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, Wartella E. Screen media exposure and obesity in children and adolescents. Pediatrics. 2017; 140(Supplement 2):S97–101.

9 Lajunen HR, Keski-Rahkonen A, Pulkkinen L, Rose RJ, Rissanen A, Kaprio J. Are computer and cell phone use associated with body mass index and overweight? A population study among twin adolescents. BMC Public Health. 2007; 7(1):1–8.

10 Rinco ´n-Pabo ´n D, Uraza ´n-Herna ´ndez Y, Gonza ´lez-Santamarı´a J. Association between the time spent watching television and the sociodemographic characteristics with the presence of overweight and obesity in Colombian adolescents (secondary analysis of the ENSIN 2010). Plos one. 2019 May 7; 14(5): e0216455.

11 Al-Agha AE, Nizar FS, Nahhas AM. The association between body mass index and duration spent on electronic devices in children and adolescents in Western Saudi Arabia. Saudi Medical Journal. 2016 Apr; 37(4):436.

12 Khan A, Burton NW. Screen-based behaviors of adolescents in Bangladesh. Journal of Physical Activity and Health. 2016 Nov1; 13(11):1156–1163.

13 Khan A, Burton NW. Screen-based behaviors of adolescents in Bangladesh. Journal of Physical Activity and Health. 2016 Nov1; 13(11):1156–1163.

14 Brodersen K, Hammami N, Katapally TR. Is excessive smartphone use associated with weight status and self-rated health among youth? A smart platform study. BMC Public Health. 2023 Feb 3;23(1):234

15 Ma Z., Wang, J., Li, J. et al. The association between obesity and problematic smartphone use among school-age children and adolescents: a cross-sectional study in Shanghai. BMC Public Health 21, 2067 (2021)

16 Bhanderi DJ, Pandya YP, Sharma DB. Smartphone Use and Its Addiction among Adolescents in the Age Group of 16-19 Years. Indian J Community Med 2021 Jan-Mar;46(1):88-92

17 Shuvo SD, Biswas BK. The degree of association between overweight and obesity with the use of electronic media among Bangladeshi adolescents. PLoS ONE 18(1): e0280544

18 Strasburger VC, Mulligan DA, Altmann TR, Brown A, Christakis DA, Clarke-Pearson K, et al. Policy statement, adolescents, obesity, and the media. Pediatrics. 2011; 128(1):201–8

19 Jordan AB, Kramer-Golinkoff EK, Strasburger VC. Does adolescent media use cause obesity and eating disorders? Adolesc Med State Art Rev. 2008; 19(3):431–49.

20 Staiano AE, Harrington DM, Broyles ST, Gupta AK, Katzmarzyk PT. Television, adiposity, and cardiometabolic risk in children and adolescents. American journal of preventive medicine. 2013; 44(1):40–7.

21 Temple J, Giacomelli A, Kent K, Roemmich J, Epstein L. Television watching increases motivated responding for food and energy intake in children. Am J Clin Nutr 2007; 85(2):355–61.

22 Dowda M, Ainsworth BE, Addy CL, Saunders R, Riner W. Environmental influences, physical activity, and weight status in 8- to 16-year-olds. Arch Pediatr Adolesc Med. 2001; 155(6):711–717.

23 McMurray RG, Harrell JS, Deng S, Bradley CB, Cox LM, Bangdiwala SI. The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. Obesity research. 2000; 8 (2):130–139.

24 Mayne SL, Virudachalam S, Fiks AG. Clustering of unhealthy behaviors in a nationally representative sample of US children and adolescents. Preventive medicine. 2020; 130:105892

25 Marsh S, Mhurchu CN, Maddison R. The non-advertising effects of screen-based sedentary activities on acute eating behaviors in children, adolescents, and young adults. A systematic review. Appetite. 2013; 71:259–73.

26 Maddison R, Foley L, Ni Mhurchu C, Jiang Y, Jull A, Prapavessis H, et al. Effects of active video games on body composition: a randomized controlled trial. The American journal of clinical nutrition. 2011; 94 (1):156–63

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3880-3888 | ISSN:2251-6727

27 Matin A. Parkar,1 Rishad Ahmed,1 Bilal Bin Abdullah,1 B.S. Patil1 and Kusal K. Das. Effect of cell phone exposure on physiologic and hematologic parameters of male medical students of Bijapur (Karnataka) concerning serum lipid profile. Journal of Basic & Clinical Physiology & Pharmacology. 2015:201-10

28 Das KK, Gupta AD, Dhundasi SA, Patil AM, Das SN, Ambekar JG. Effect of L-ascorbic acid on nickel-induced alterations in serum lipid profiles and liver histopathology of rats. J Basic Clin Physiol Pharmacol 2006;17(l):29-44

29 Vangelova K, Deyanov C, Israel M. Cardiovascular risk in operators under radiofrequency electromagnetic radiation. Int J Hyg Environ Health 2006;209(2):133-138

30 Kim J, LaRose R, Peng W. Loneliness as the cause and the effect of problematic internet use: the relationship between internet use and psychological well-being. Cyberpsychology & behavior. 2009;12(4):451–455.

31 De-Sola Gutiérrez J, Rodríguez de Fonseca F, Rubio G: Cell-phone addiction: a review. Front Psychiatry. 2016, 7:10.3389

32 McLaren L, Beck CA, Patten SB, Fick GH, Adair CE. The relationship between body mass index and mental health. Soc Psychiatry Psychiatr Epidemiol. 2008;43(1):63–71.

33 Ramic E, Kapidzic-Durakovic S, Karic E, Batic-Mujanovic O, Zildzic M. Influence of lifestyle on overweight and obesity in school-age children. Medical Archives. 2009;63(5):284.

34 Liu Q-Q, Zhang D-J, Yang X-J, Zhang C-Y, Fan C-Y, Zhou Z-K. Perceived stress and mobile phone addiction in Chinese adolescents: a moderated mediation model. Comput Hum Behav. 2018;87:247–253.

35 Demirci K, AkgöNül M, Akpinar a: relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. J Behav Addict. 2015;4(2):85–92

36 Choi HS, HK LE, Ha JC. The influence of smartphone addiction on mental health, campus life, and personal relations - focusing on K university students. Journal of the Korean Data & Information Science Society. 2012;23(5):1005–1015.

37 Guram, Sheena, Heinz, Peter: Media use in children: American Academy of Pediatrics recommendations 2016. Archives of disease in childhood Education and practice edition 2018, Media use in children: American Academy of Pediatrics recommendations 2016, 103, 2, 2101

38 Ryu Seaun 1, Jang Hajin 2, Oh Hannah. Smartphone Usage Patterns and Dietary Risk Factors in Adolescents. The Journal of Nutrition Volume 152, Issue 9, September 2022, Pages 2109-2116

39 Byun D, Kim R, Oh H. Leisure-time and study-time Internet use and dietary risk factors in Korean adolescents. Am J Clin Nutr, 114 (5) (2021), pp. 1791-1801

40 Kumar S, Rajasegaran R, Prabhakaran S, Mani T. Extent of smartphone addiction and its association with physical activity level, anthropometric indices, and quality of sleep in young adults: A cross-sectional study. Indian J Community Med 2024;49:199-202

41 Touitou Y, Touitou D, Reinberg A. Disruption of adolescents' circadian clock: The vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. J Physiol Paris 2016;110:467-79.