

## “Effect of Gaming on Unstimulated Salivary Flow and pH among Young Adults in Moradabad City.”

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### Abstract:

**Objective:** To estimate the effect of gaming on un-stimulated salivary flow and pH among young adults. **Materials and Methods:** A Sample of 200 young adults was recruited for the study. Information regarding gaming activity was recorded using a scale of Internet Disorder (IGD Scale). Psychometric symptoms were assessed using DASS-21 and the evaluation of salivary pH and flow (un-stimulated saliva) among the subjects were checked using pH meter and rate measurement (ml/min) respectively. **Results:** The characteristics of gaming patterns were identified among the participants. A strong correlation was seen with IGD scores and DASS-21 scale for Depression, Anxiety and Stress and also for salivary parameters like flow and pH. The comparison of mean scores was seen from the results with a statistical significant difference in relation to Depression, Anxiety, Stress and Salivary parameters. **Conclusion:** It was concluded that the participants who met the IGDS (Internet gaming disorder scale) criteria for video game addiction displayed more depression, anxiety and stress which was directly related to less salivary flow and lower salivary pH.

**Keywords:** Anxiety, Depression, Internet gaming disorder, Salivary parameters, Stress

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### I. Introduction:

Video games have become a normative part of the culture today. For most video game players, video games are a harmless way to relive stress, socialize with peers, and spend time. However, there is evidence that for some individuals, video game play can interfere with social functioning and well-being and make one's life addicted to it. Video game addiction has been associated with a variety of negative psychological and social outcomes including increased aggression, guilt, depression and anxiety.<sup>1</sup> Research into the effects of gaming on human health has grown substantially during the past decade. Although the positive effects of healthy gaming have been demonstrated by a large body of research, numerous studies have systematically reported potentially harmful effects that games can have on human health due to its potentially addictive properties and overall detrimental effects in several life domains for a minority of gamer. Such harmful effects related to addiction to gaming can include decreased levels of exercise and sports, impaired decision-making, poorer psychosomatic health, greater incidence of psychiatric symptoms, lower expected college engagement and grades in adolescent students, and compromised prefrontal cognitive control over emotional interference, in addition to other psychiatric disorders and abnormal behaviours. All these negative aspects can cause a significant effect on reducing salivary flow rate and pH that can lead to dental caries and bad gingival health. Reduced salivation can lead to some after effects such as speech problems, chewing disorders, inflammation of the mucosa (mucositis), oral Candida infections and mucosal atrophy. It can increase accumulation of plaque and decrease the saliva buffering capacity<sup>2</sup>. Currently, there is a lack of knowledge about Internet gaming and its effect causing increased Depression or Anxiety. In enlightening, the latest (fifth) edition of the American Psychiatric Association's (APA) Diagnostic and Statistical Manual (DSM) of Mental Disorders included Internet Gaming Disorder (IGD) as a condition that needs further research before being fully recognized and accepted as an independent disorder in subsequent publications of the DSM. The clinical diagnosis of IGD comprises a behavioural pattern encompassing persistent and recurrent engagement with online and offline games, leading to significant impairment or distress over a 12-month period as indicated<sup>3</sup>.

Hence, this present study can help to identify the gaming disorders relation to the students involved in Gaming and help in better understanding of the problems related to it. The study designed to estimate the

characteristic of gaming pattern using IGD scale and the effect of gaming on un-stimulated salivary flow and pH among young adults in Moradabad city.

## **II. Materials And Method:**

The present study was conducted to assess the effect of gaming on un-stimulated salivary flow and pH among young adults' population in Moradabad, India. Convenient sample from the college were recruited and were examined in the department with questions and clinical examination. 200 students aged between 17-25 years from dental college who were having an exposure to smart phones/tablets/computers with internet were recruited for the study. All the voluntary participants were assured of anonymity and confidentiality, and the study was granted approval by the institutional ethics and review board KDCRC, Moradabad. (KDCRC/IERB/10/2019/01)

### *Measures:*

The study assessed socio-demographics and characteristics of gaming pattern, IGD rating, DAS rating through questionnaire and evaluation of salivary pH and flow by clinical examination.

### *Socio-demographics*

The survey included questions relating to gender, age, relationship status, the primary time of playing any game (online and/or offline), time and duration (weekly) spent on the game (morning, evening or night), money spent on games, use of psychoactive substances (i.e., cigarettes and alcohol) in order to map onto excessive substance use behaviours, ownership of mobile device with internet access, and ownership of gaming console and/or other gaming devices were collected.

### *Internet Gaming Disorder Scale – Short-Form (IGDS9-SF)*

The IGDS9-SF is a short psychometric tool reflecting the 9 core criteria that defines the Internet Gaming Disorder. This instrument assesses the severity of IGD and its detrimental effects by examining both online and/or offline gaming activities occurring over a 12-month period on a 5-point Likert scale: 1 (“Never”), 2 (“Rarely”), 3 (“Sometimes”), 4 (“Often”), and 5 (“Very Often”). The scores are obtained by summing the answers and the total scores can range from 9 to 45, with higher scores being indicative of higher degrees of gaming disorder.<sup>4</sup> The reliability for the IGD scale was  $\alpha = 0.88$  for this study population.

### *Psychiatric symptoms*

Symptomatology of depression, stress, and anxiety was assessed with the Depression Anxiety and Stress Scale–21 (DASS-21), which comprises three seven-item subscales covering the three symptoms that are rated on a 4-point scale (i.e., 0 = “Did not apply to me at all” to 3 = “Applied to me very much, or most of the time”).<sup>5</sup> The reliability for DAS Scale was  $\alpha = 0.87$  for this study population.

### *Evaluation of Salivary pH*

The evaluation of salivary pH among the subjects was checked by a single electrode digital pH meter (Checker<sup>®</sup> pH Tester – HI98100 by Hanna Instruments). Saliva was collected as per the protocol derived from the World Health Organization/International Agency for Research on Cancer guideline “Common Minimal Technical Standards and Protocols.” Saliva samples were obtained in the morning during which subjects were asked not to drink any beverages except water. The subjects were given drinking water to rinse their mouth out well (without drinking water) before commencement. 5 min after this oral rinse, the subject was asked to spit whole saliva in the collecting cup. The subjects were also asked not to cough up mucus as saliva is collected<sup>6</sup>. The pH of the saliva was immediately measured in order to prevent any deterioration of the sample.

### *Evaluation of Salivary flow*

The evaluation for un-stimulated saliva was done by draining method. The subjects were instructed not to eat or drink anything 1 hour before the commencement of the test. They were asked to rinse the mouth thoroughly with water prior to the collection trial. They were seated comfortably with eyes open, head tilted slightly forward with mouth open, instructed to rest for 2 minutes and to minimize oro-facial movements. Saliva is allowed to drip off the lower lip into a graduated test tube and the subject expectorates into the test tube at the end of the collection period. The time was noted and calculated using the unitary method and that determines the salivary flow in ml/minute.<sup>7</sup>

**Data Management**

Data collection was done by a single interviewer. The survey was carried out between September to October, 2019. Correlation coefficient was calculated using *Spearman’s Rho ( $r_s$ )* as the data was not following the normal distribution when checked by *Kolmogorov-Smirnov test*. Statistical significance was set at  $p$  value  $\leq 0.05$ . The comparative analysis was done using *Wilcoxon Signed-Ranks test*. Statistical significance was set at  $p$ -value  $\leq 0.05$ .

**III. Result:**

Around 200 participants in the age group of 17-27 years (mean age  $21.8 \pm 5$ ) participated in study, and the response rate was 100%. Based on scores from the Internet gaming disorder questionnaire, participants were classified according to the scores. Higher scores are indicative of a higher degree of Internet Gaming Disorder. Those who responded Often or Very Often to 5 or more items were classified as Gamers (N=92). Participants who played video games, but responded to Often or Very Often on 4 or fewer questions were considered as Non Gamers (N=108). The Characteristics of the participants and their gaming patterns are presented in **TABLE 1**.

**TABLE 1: Characteristics and Gaming patterns of Participants**

<b>Age</b>	<b>17-27 years of age, Average : 21.8±5</b>
<b>Time of Playing the game</b>	
Gamers	Night (86.9%) Evening (13.04%)
Non Gamers	Don’t play (76.8%) Anytime of the day (23.1%)
<b>Money spend on gaming (monthly)</b>	
Gamers	No money (75%) Less than 700 Rupees (23.9%)
Non Gamers	No money (88.8%) Less than 700 Rupees (11.2%)
<b>Time spend on Gaming per week</b>	
Gamers	8-14 hours (82.6%)
Non Gamers	Less than 8 hours (100%)
<b>Device used for Gaming</b>	
Gamers	Mobile Device (85.8%) Console (14.2%)
Non Gamers	Mobile Device (94.4%) Console (5.6%)

The correlation of Psychiatric symptoms and salivary parameters with IGD scores are shown in **TABLE 2**. A strong correlation was seen with IGD scores and DASS-21 scale for Depression ( $r_s= 0.60$ ) Anxiety ( $r_s=0.65$ ) and Stress ( $r_s=0.61$ ) and also for salivary parameters like flow ( $r_s= 0.63$ ) and pH ( $r_s= 0.67$ ).

**TABLE 2: Correlation of IGD scores with DAS and Salivary Parameters**

	Correlation between IGD scores with Psychiatric symptoms			Correlation between IGD scores and salivary parameters	
	Depression	Anxiety	Stress	pH	Flow
<b>IGD scores</b>	0.60	0.65	0.61	0.67	0.63
<b>p Value</b>	0.0155	<0.00001*	0.0056*	<0.00001*	<0.00001*

\* $p < .05$ . Correlation by *Spearman’s Rho ( $r_s$ )*

**TABLE 3** compares the mean scores of psychometric variables and salivary parameters between Gamers and Non-gamers. It is seen from the results that there is a statistical significant difference with relation to Depression, Anxiety, Stress and Salivary parameters among Gamers and Non-gamers.

**TABLE 3: Mean Scores of Gamers & Non-Gamers**

	IGD	Depression	Anxiety	Stress	pH	Flow
<b>Gamers</b>	27.5	35.7	26.0	28.1	6.07	0.19
<b>Non-Gamers</b>	16.4	15.5	12.9	12.9	6.90	0.30
<b>p Value</b>	0.024	<b>0.000*</b>	0.054	<b>0.000*</b>	<b>0.000*</b>	0.180

\*p < .05. Wilcoxon Signed Rank Test

#### IV. Discussion:

The present study assessed the effect of gaming (IGD scale) on un-stimulated salivary flow, pH and psychiatric symptoms (*viz.* Depression, Anxiety and Stress). This scale is widely used to measure the video game addiction.<sup>4</sup>The IGDS9-SF comprising 9 items questionnaire, serves as a valid and reliable instrument to stimulate research on Internet Gaming Disorder. The IGD score measures the video game addiction by assessing the relationship between participants whose scores would qualify them as video game addicts (Gamers) and Non addicts (Non gamers).

The study also identified the characteristics of Gamers and Non gamers. Among gamers; the frequency of gaming was more during night as they have more solitary time during the night and less elements for distraction. The weekly invested time was 8-14 hours and they mostly spend gaming via mobile phones (85.8%) and less on consoles as per the availability. Similar result was reported by Tzu-Yi Wu, et.al. (2017).<sup>8</sup>

There is a strong correlation of Internet Gaming Disorder with Psychometric scale (DASS-21). The correlation coefficient values of Depression, anxiety and stress was  $r_s = 0.60, 0.65,$  and  $0.61$  respectively.

The playing hours and the time spent on videogames affect the sleeping patterns among gamers and in turn can lead to insomnia, affecting the psychology of the person and disrupting the normal and healthy functioning during the day. This can be the leading cause of **Depression**. Students who have high internet gaming disorder (gamers) tend to be depressed. Similar findings were reported by Ryu, et al. (2018)<sup>9</sup> who found that internet gaming disorder was significantly, positively related to depression.

In present study, there was a significant correlation between Internet Gaming Disorder and **Anxiety**. Similar findings were reported by Mehroof, et al. (2010)<sup>10</sup> who found that state anxiety and trait anxiety were significantly related with gaming addiction. Wang, et al. (2005) investigated interpersonal relationships and social anxiety among video game players and reported that as time spent on online games increased, social anxiety increased and the quality of interpersonal relationships decreased. Online games may temporarily assuage feelings of social anxiety; they do nothing to improve real-world social relationship.

There is a strong correlation of IGD score with **Stress** which might be due to more time invested in gaming which in turn leads to stressed behaviour, loss of concentration and poor working efficiency. Similar findings were reported by Kaess, et al. (2017)<sup>11</sup> who reported that stress reactivity was correlated with severe symptoms of internet gaming disorder.

These Psychiatric symptoms were seen increased in Gamers due to their hard-core gaming and less social and physical activities. Addiction to video games was contributing to depression; anxiety and low self-esteem in players, affecting them both psychologically and physically. Gamers are being seen more nervous during the day time and stressed due to their last game they played and for the future games they will play.<sup>12</sup>

The study found a strong correlation between Internet Gaming Disorder and Salivary Parameters (pH and Flow). The correlation coefficient values of pH and Flow are  $r_s = 0.67, 0.63$  respectively. Salivary pH and Flow among Gamers was less compared to Non Gamers.

The saliva that basically forms the environment of the mouth is that of the resting or pooled saliva. Saliva features a normal pH range of 6.2-7.6 with 6.7 being the typical pH.<sup>13</sup>

Decrease in salivary pH is seen in stressed or depressed situations, due to activation of the HPA axis and the sympathetic nervous system in reaction to stressful experience<sup>14</sup>. These stressful situations might develop from increased gaming causing the rise in acidity of saliva (acidic pH).

Generally, an altered cortisol awakening response is seen as an indicator of stress and stress-related changes in HPA-regulation. A saliva pH below normal range usually indicates acidemia (abnormal acidity of the blood). If a chronic condition exists, the mouth is more vulnerable to dental decay, halitosis and periodontitis. Chronic acidemia is often a causative factor for a mess of diseases affecting the entire body. Other studies suggested that changes in pH levels be an antecedent to the dysregulation of other saliva components in reaction to stressors, such as cortisol reported by Hellhammer DH, 2009<sup>15</sup> & Levine A, 2007<sup>16</sup>, sIgA or alpha-amylase reported by Papacosta E, 2011.<sup>17</sup>

In present study, a strong correlation was found between the un-stimulated salivary flow and Internet Gaming Disorder. It was inferred that, as the IGD increases, the flow is seen decreasing. In patients with a low unstimulated salivary flow rate, clearance of bacteria and desquamated epithelial cells is reduced greatly, increasing the tendency for halitosis to develop, especially before breakfast reported by Turner MD, 2007<sup>18</sup>. From the previous study it was seen that as the cortisol level increase, the flow is expected to decrease (This correlation was seen by Cyril Brom et al, 2014<sup>19</sup>) which is also seen with pH of the saliva in our study. It

can be inferred that as IGD increases psychometric symptoms in the human body, it causes the flow and pH to decrease hence making the oral cavity prone to caries because of lower pH (more acidic) and bad oral health.

## V. Conclusion

In the present study, participants who met the IGDS (Internet gaming disorder scale) criteria for video game addiction showed more depression, anxiety and stress which was directly related to less salivary flow and lower salivary pH (more acidic) which can hamper the tooth and periodontal tissues integrity. As the gamers invested more time in gaming it affected their sleeping pattern. The disturbances in sleeping led to insomnia and depression. Therefore, it is advised to invest their leisure time into physical activities and exercise that might make their lifestyle mentally and physically healthy. For reduced salivary flow and acidic pH, salivary stimulants (like xylitol gums, fennel seeds) are helpful in maintaining the regular flow and neutralizing salivary pH. Since the literature on association between Internet Gaming Disorder and Oral diseases/conditions are limited, therefore more studies should be carried out since it is affecting a wider range of generation.

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