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Hot Executive Functions, Emotional Behavior Problems and Well-Being in Young Vape Users

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Abstract

Vaping is becoming quite popular among young adults, raising concerns regarding its impact on their mental health and functioning. New evidence ties nicotine use to interference with emotion regulation and risky decision-making, which are both central to hot executive functions (Buchmann et al., 2021). Deficits in these domains are also related to emotional and behavioral problems and a lower level of psychological well-being (Pentz et al., 2023). This study attempts to explore the relationships between hot executive functions, problems in emotional behavior, and well-being among young vape users. Hot executive functions, emotional-behavioral problems, and well-being were assessed in 500 Pakistani vape users aged between 18 and 27, using a correlational cross-sectional design. The participants completed the ERQ, MCQ, SDQ, and PERMA Profiler. Descriptive statistics, Pearson correlations, and Anova were performed. The data show a negative correlation between executive dysfunctions (impulsivity and emotion dysregulation) from a well-being perspective. Moreover, difficulties in emotion regulation were positively correlated with emotional behavior problems, thus producing anxiety and conduct problems. The sample was taken using snowball sampling technique. Informed consent was taken from each participant and proper ethical considerations were followed. Statistical analysis used correlation, regression, ANOVA and descriptive statistics. The findings indicated that hot executive functions (Emotion Regulation, Risky Decision Making) had a positive correlation with well-being and a negative correlation with emotional problems. In the results of regression analyses, hot executive functions significantly predicted emotional problems and well-being. In ANOVA, results showed that emotional behavior problems were different in education and other substance use while well-being differ in gender and early history of substance use. It concluded that there was a poor emotion regulation, particularly when the users suppressed with aggravated distress and lower well-being. The difference appeared in gender, where men were more suppressed and women had more emotional troubles.

Keywords: Vaping, Hot Executive Functions, Emotional Behavior Problems, Well-Being, Young Vape Users

Introduction

The use of electronic cigarettes (e-cigarettes) or vaping devices has become a very common trend amongst young adults between the ages of 18 to 25 over the past couple of years. Although

positioned as less harmful than smoking tobacco, neuropsychological and emotional risks are beginning to emerge in the neuropsychological literature regarding the frequent use of nicotine via vaping (Yuan et al., 2015). Nicotine has an impact on executive functioning systems in the brain, particularly those involved in emotion and decision-making, which is why young users are especially susceptible Hot Executive Functions deficiency and related emotional problems (Camenga et al., 2018).

Hot Executive Functions (HEFs) are a group of EFs that play a role in emotionally fraught conditions, including the need to regulate emotion and to appraise rewards (Zelazo & Carlson, 2012). Emotion regulation and risky decision-making are two important elements that are at the center stage of ensuring psychological well-being. Emotion regulation is the capacity to control and alter emotional responses through such techniques as cognitive reappraisal or expressive suppression (Gross, 1998).

The propensity to make decisions relating to possible harm to achieve immediate outcomes is commonly assessed in substance-using samples by administering tasks such as the Monetary Choice Questionnaire (Bickel et al., 2012). The long-term vaping can also influence Emotional Behavior Problems that refer to both internalizing (e.g., emotional symptoms, peer problems) and externalizing (e.g., hyperactivity, conduct issues) problems. The Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) is one of the measurements that can be reliably used to assess these issues and additionally includes prosocial behavior as one of the protective factors, which reflects the empathy and willing-to-cooperate behavior.

Youth with impaired executive functions have been connected to more considerable emotional dysregulation and lowered prosocial behavior (Moffitt et al., 2011). Lastly, such cognitive and emotional disruptions can negatively affect psychological health especially in terms of the PERMA model- Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment (Seligman, 2011). The lack of well-being is prevalent among people who lack regulation and have increased emotional problems (Ford & Mauss, 2015).

Literature Review

The use of vape has quickly grown into a widespread habit among young adults, especially because it is readily available, seems to be safe, and socially approved. Nevertheless, a growing body of literature underscores the mental and emotional effects of regular nicotine vaping. Studies have also discovered that nicotine affects the reward system in the brain, especially in adolescents and young adults, thus hindering control mechanisms and making them more impulsive (Yuan et al., 2015). These changes are connected with Hot Executive Functions (HEFs), including emotion regulation and risky decision-making.

Emotion regulation Emotion regulation is an important factor of self-control and psychological resilience. Gross (1998) maintained that people employ cognitive strategies in the regulation of their emotions, such as reappraisal or suppression. The substance use, such as nicotine, that results in poor regulation is linked with elevated levels of emotional instability and maladaptive behavior (Aldao et al., 2010). In a similar way, risky decision-making can be described as an evaluation of rewards versus consequences and it was found that nicotine use results in a bias in favor of immediate rewards, not taking the long-term consequences into consideration (Bickel et al., 2012). This impulsive decision-making tendency has mostly been measured using tools such as the Monetary Choice Questionnaire (MCQ).

Executive dysfunction also indicates close connections with emotional and behavioral problems. Strengths and Difficulties Questionnaire (SDQ) is widely applied to rate emotional symptoms, hyperactivity, conduct problems, peer issues, and prosocial behavior. According to the research, the malfunctioning of executive function may combine with poor behavior regulation, lack of empathy, and social malfunctioning (Moffitt et al., 2011). It affects negatively, in particular, the

prosocial subscale of the SDQ in the case where there is a compromise in emotion regulation and impulsivity.

According to the PERMA model presented by Seligman, well-being encompasses positive emotions, engagement, relationships, meaning, and accomplishment (Seligman, 2011). Poor regulation of emotions or increased risk-taking in young adults has been associated with lower well-being reports and increased psychological distress. Cognitive self-regulation and emotional behavior problems have been demonstrated to forecast overall life satisfaction and flourishing (Ford & Mauss, 2015).

Research Gap

Although the world is becoming more aware of the use of e-cigarettes, little research has been done regarding the psychological effect on young users, especially in non-Western regions such as District Punjab, Pakistan. Available literature has dealt mostly with Western inhabitants without touches on variables associated with culture and context e.g. possibility of peer influence, societal norms, and availability. There is a big gap in identifying the effect of vaping on hot executive processes; such processes involve cognition using an emotional route, such as regulation of emotion and decision-making under risk. Such functions are especially significant during adolescence when feelings are intense and one is more cognitively vulnerable. Furthermore, the relationship between hot executive functions and emotional behavior problems (EBPs) in the domain of vaping have never been explored thoroughly.

As much as others have identified EBPs as mental health problems, not many studies have taken them as psychological outcomes of EBPs. The current study attempts to address these gaps by identifying a culturally unique population of interest and offering insights on the effect of vaping in modifying executive and emotional functioning. The results will guide culturally reasonable interventions and population health plans that affect the well-being of young people.

Methods

Study Design, Setting, and Participants

In October 2024, this correlational study was carried out. Individuals between the ages of 18 to 27, who use nicotine vapes, were included in the study. The final group included 500 young adults who were studying in universities at both public and private institutions across Pakistan. Those who took part did so by choice and recruitment involved both meeting people in person and using the internet. Google Forms were used to send out a digital questionnaire and we encouraged participants to complete the survey using WhatsApp and Instagram. A convenient sampling method with snowball technique was applied, so survey participants were urged to allow their contacts who met the inclusion criteria to participate.

Questionnaire

Participants completed an online questionnaire that contained tested and approved scales measuring emotional, mental and general well-being. The survey was carried out in English and covered five different areas. Demographic and social details – Among them are age, the participant's gender, what level of education they have and the length of vaping. Emotion Regulation – Determined by using the Emotion Regulation Questionnaire (ERQ) which looks at two strategies: thinking differently about emotions and keeping them hidden. Measured with the Monetary-Choice Questionnaire (MCQ) which reviews how quickly subjects make decisions and how much their choices are discounted by time. Emotional Behavior Problems – Identified using the SDQ which looks at emotional difficulties, bad behavior and problems with friends. Using the PERMA Profiler, we check five features of well-being: Positive emotion, Engagement, Relationships, Meaning and Accomplishment. Prior to using the study sample, the questionnaire

was tried out and checked for clarity with a number of university students. Some changes were made after opinions from psychology and behavioral sciences reviewers were taken into account.

Sampling and Data Collection

To collect data, we used trained assistants who sent the study link to their university email lists and online academic groups. People taking part in the study received an explanation of its goals and signed an informed consent form before getting started. No personal data was collected as each participant could respond in anonymity. All data was collected at some time between 5 and 25 October 2024. Survey takers were advised to finish the survey at once and it should take approximately 15–20 minutes to complete. We tried to represent as many kinds of young adult vape users in Pakistan as possible.

Ethical Consideration

The study was given approval by the Vice Chancellor of Government College University Faisalabad and Head of Department of Applied Psychology. All participants were asked to give digital consent before starting the questionnaire. Those taking part were promised their responses would be kept private and their anonymity would be protected. The study was conducted in accordance with the standards set in the American Psychological Association. There was no space for engagement by people using healthcare services in this research.

Data analyses

Data were gathered in Google Forms, downloaded to Microsoft Excel and then imported into SPSS for analysis. All incorrect or invalid data was removed from the file before beginning the analysis. Information about age, gender, religion, type of family, number of siblings, socioeconomic status, education and income was gathered and described using frequencies and percentages. A measurement of the consistency and dependability of the study tools was done through Cronbach's alpha. Pearson correlation analysis was used to investigate how the central variables relate to each other linearly. Different statistical methods were used such as t-tests, ANOVA to study how different groups compared and to find relationships that could predict outcomes. Mediation analysis was run to check for the indirect affects among the variables. All of these statistical analyses let us carry out an in-depth evaluation of the hypotheses and made it easier to understand how each variable worked with the others in the research. Stepping through each variable, we looked for ones that were significantly ($p \leq 0.250$) related to well-being by what we found in the earlier analysis. Only those variables meeting the cutoff point were used in the regression calculation. A stepwise process was employed to single out variables that independently and significantly ($p < 0.05$) affected well-being in the final result. For each variable, I reported the standardized coefficient (β) and confidence interval (CI). Analysis of the scales included—the ERQ, MCQ, SDQ and PERMA Profiler—shows that each subscale was valid, with Cronbach's alpha values above 0.70. It presented the basic data about groups and main variables. Pearson's correlation was used to look for straight relationships between hot executive functions, emotional issues and personal well-being. Comparisons across groups were made by using independent samples t-tests and one-way ANOVA for demographic variables. Out of the 500 participants, all were young adult nicotine vape users. We decided on the sample size using earlier studies and power analyses, so we could detect medium effect sizes in 95% of the cases and achieve 80% power for analyzing the links between psychological variables without considering demographics.

Results

Table 4.1

Demographic statistics of young vape-users. (N=500)

Characteristics	Categories	M	SD	n	%
Age	18-22	22.38	2.24	222	44.4
	23-25			271	54.2

	25-27			7	1.4
Education	Matric	1.97	0.826	40	8.0
	Intermediate			58	11.6
	Bachelors			279	55.8
	Masters			123	24.6
Year of Starting Vaping	Upto 3	2.47	1.58	389	77.8
	Above 3			111	22.2
Any Other Substance Use	None	1.00	0.945	160	32.0
	Smoking			240	48.0
	Velo			38	7.6
	Any Other			62	12.4
Early History of Substance	None	1.73	0.540	157	31.4
	Smoking			319	63.8
	Substance			24	4.8

The table describes important demographic and behavioral characteristics of the participants. The majority of them were between 23-25 years old, and a smaller number were between 18-22; there were very few older than 25. Most of them were having a Bachelor's degree, then Masters and intermediate education. The majority of the participants started vaping in the past three years. Almost a half of them were current smokers and the rest used no substances or alternative such as Velo. Most of them also have a history of smoking in their younger years.

Table 4.2

Family and Socio-demographic characteristics of young vape-users. (N=500)

Characteristics	Categories	Frequency (n)	Percentage (%)
Gender	Male	346	69.2
	Female	154	30.8
Father Age	35–50	193	38.6
	51–65	131	26.2
	Not reported	176	35.2
Father Education	Uneducated	23	4.6
	Matriculation	96	19.2
	Intermediate	127	25.4
	Bachelors	59	11.8
	Masters	19	3.8
	Not reported	176	35.2
Mother Age	35–50	240	48.0
	51–65	84	16.8
	Not reported	176	35.2
Mother Education	Uneducated	23	4.6
	Matriculation	96	19.2
	Intermediate	127	25.4
	Bachelors	59	11.8
	Masters	19	3.8
	Not reported	176	35.2
Siblings	None	5	1.0
	1 to 5	476	95.2
	More than 5	19	3.8
Family Income (PKR)	20,000–95,000	243	48.6
	100,000–195,000	184	36.8
	200,000–500,000	73	14.6

Family System	Joint	142	28.4
	Nuclear	358	71.6
Area of Living	Lahore	216	43.2
	Islamabad	47	9.4
	Faisalabad	95	19.0
	Sahiwal	93	18.6
	Bhakkar	49	9.8

The samples used were mainly males. The majority of fathers and mothers were of the age 3550 years, but a big percentage failed to mention their age and education. Of the ones that did, the most frequent level of education amongst both parents was intermediate followed by matriculation. Most of the interviewees indicated that they had between 1 and 5 siblings. The family income was between low and upper-middle with the majority falling on the lower scales. A great percentage of respondents were nuclear families. The participants basically belonged to the cities such as Lahore, Islamabad, Faisalabad, Sahiwal, and Bhakkar. The university affiliations were almost equally divided into government and privately owned institutions whereas others failed to report their university affiliations.

Table 4.3

Reliability parameters of the Scales and Subscales of the study.

Measures	K	a	M	SD	Min.	Max.	Skewness	Kurtosis
Emotion regulation	6	.91	19.43	7.871	6.00	42.00	-.153	-.567
Emotion regulation reappraisal	3	.92	8.82	3.923	3.00	21.00	.479	-.039
Emotion Regulation suppression	3	.89	10.60	4.7696	3.00	21.00	-.165	-1.117
Emotional behavior problems	20	.91	19.76	9.697	6.00	38.00	.490	-1.288
Emotional behavior problems internal	10	.77	9.75	4.662	2.00	20.00	.447	-1.280
Emotional behavior problems external	10	.88	10.00	5.325	2.00	20.00	.500	-1.151
Emotional behavior problems prosocial	5	.78	5.79	1.999	.00	10.00	-.285	-.659
Well being	15	.94	4.71	1.356	1.20	10.00	-.251	.211
Well-being positive	3	.86	4.58	1.532	1.00	10.00	-.271	.285
Well-being engagement	3	.32	5.03	1.194	1.00	10.00	.235	2.044
Well-being relationship	3	.83	4.65	1.570	1.00	10.00	-.283	.027
Well-being meaning	3	.90	4.59	1.643	.33	10.00	-.059	-.356
Well-being accomplishment	3	.87	4.72	1.606	1.00	10.00	.085	.309
Risky decision making	9	.90	4.41	3.041	.00	9.00	.137	-.913

The analysis of reliability depicted that all the measures had high internal consistency. Emotion Regulation had an alpha of.908, and subscale means of 8.83 (Reappraisal) and 10.60 (Suppression). Emotional Behavior Problems had 913, whilst Risky Decision-Making had 902. Well-Being was very reliable (0 =.946), with subscales ranging between 4.58 and 5.04. The distribution of all the variables was almost normal as indicated by the values of skewness and kurtosis.

Table 4.4:
Table of Correlation Matrices.

#	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Reappraisal**	-	.636**	.884**	.004	-.336**	-.352**	.427**	-.355**	.628**	.473**	.554**	.588**	.546**	.625**
2	**suppression**		-	.923**	.023	-.434**	-.457**	.496**	-.460**	.652**	.411**	.534**	.531**	.523**	.596**
3	**Emotion regulation**			-	.016	-.431**	-.452**	.513**	-.455**	.708**	.485**	.599**	.614**	.590**	.672**
4	**Risky decision making**				-	-.094*	-.090*	.075	-.095*	.020	-.007	.032	.003	.010	.014
5	**Internalizing**					-	.884**	-.333**	.967**	-.363**	-.202**	-.363**	-.296**	-.292**	-.343**
6	**Externalizing**						-	-.373**	.975**	-.420**	-.233**	-.389**	-.335**	-.330**	-.385**
7	**Prosocial**							-	-.365**	.501**	.335**	.461**	.327**	.428**	.460**
8	**EBPs**								-	-.405**	-.226**	-.388**	-.327**	-.322**	-.376**
9	**Well -Being**									-	.694**	.807**	.811**	.827**	.927**

10	**engagement**	-	.555**	.732**	.745**	.815**
11	**relationship**		-	.737**	.733**	.864**
12	**meaning**			-	.870**	.931**
13	**accomplishment**				-	.935**
14	**Well being**					-

The table indicates the inter-correlations of emotion regulation, emotional behavior problems, well-being, and risky decision-making. Emotion regulation was associate-moderately negatively with emotional behavior problems and well-being. Emotional behavior problems displayed the high internal association and negative correlation with well-being subscales. Well-being had a great connection with its subscales and a negative correlation with emotional problems. Risky decision-making was weakly and largely non-significantly correlated with the other variables.

Table 4.5

Independent sample t-test comparing gender differences in Hot Executive Functions, Emotional Behavior Problems and Well-Being (N=500)

Variables	Males (M)	SD	Females(M)	SD	t	P	Cohen's d
suppression	10.94	4.44	9.84	5.38	2.38	.018	0.213
EBPs	18.73	9.62	22.07	9.50	-3.60	.000	-0.360
Internalizing	9.22	4.56	10.97	4.67	-3.95	.000	-0.362
Externalizing	9.51	5.30	11.10	5.23	-3.10	.002	-0.278

The analysis of gender differences indicated several significant findings. Females scored significantly higher on the emotional behavior problems and internalizing emotional behavior problems than males, both at moderate effect sizes (cohen's d=-0.360 and cohen's d=-0.362). These findings indicate that females could experience a greater level of emotional- and behavioral-related difficulties concerning both internalizing problems and general emotional and behavioral self-regulation. Conversely, females score higher on externalizing emotional behavior problems at small effect sizes (cohen's d=-0.278), indicating that emotional and behavioral issues in externalizing tend to be higher among females. Furthermore, males scored higher on emotion regulation supression (emotion suppression) at small effect sizes (cohen's d=0.213), suggesting that they would be more likely to suppress emotions than their female counterparts. These results suggest considerable gender differences in emotional and behavioral tendencies, with females exhibiting greater internalizing and externalizing problems and males more likely to suppress emotions.

Table 4.6

Analysis of Variance (ANOVA) showing the role of Age, Gender, Education,Any Other Substance Use, Early History of Substance use and Years of Starting Vaping in Emotional Behavior Problems and Well-Being. (n=500)

Source	Dependent Variable	SS	Df	MS	f	p	η^2p
Education	EBP	2466.25	3	822.08	9.72	<.001	.057
Gender	Well-Being	9.229	1	9.229	5.321	.021	.011
Early history of substance	Well-Being	63.947	2	31.973	20.237	.000	.078
Any other substance use	Well-Being	17.004	3	5.668	3.588	.014	.022
Any other substance use	EBP	3914.029	3	1304.676	19.146	.000	.107

Results from the factorial ANOVA analyses revealed several significant main effects across both dependent variables, namely emotional behavior problems (EBP) and well-being.

For emotional behavior problems, there was a significant main effect for education, $F(3, 480) = 9.72$, $p < .001$, $\eta^2p = .057$, suggesting that there is a meaningful association between educational level of the participant and his or her emotional behavioral problems. There was also a strong main effect found for any other substance use on EBP, $F(3, 480) = 19.146$, $p < .001$, $\eta^2p = .107$, meaning that, in general, those who were using some other substances manifested more of that emotional dysregulation.

There were significant effects on well-being for three variables. Gender had a small but meaningful effect on well-being, $F(1, 480) = 5.321$, $p = .021$, $\eta^2p = .011$, thus suggesting

differences in subjective well-being for male and female respondents. Moreover, early substance use history did well in predicting well-being, $F(2, 480) = 20.237$, $p < .001$, $\eta^2p = .078$, as well as any other substance use, $F(3, 480) = 3.588$, $p = .014$, $\eta^2p = .022$. These findings highlight an inverse relationship between substance use involvement and well-being. Overall, the results emphasize that both educational background and substance use history play a significant role in the psychological functioning of participants, affecting both their emotional behavior and well-being.

Discussion

This paper will discuss the effects of the popularity of vaping among young users in terms of both demographic and psychological trends. Most of the participants were aged 23-25, which corresponds to earlier establishments that vaping among young people is gaining more and more popularity (Kowitt et al., 2019). Despite the stereotypes, a significant number of participants were either students or graduates of universities, a fact that agrees with the scientific literature data indicating the development of vaping tendencies among educated members of the younger generation (Loukas et al., 2018). According to it, the use of e-cigarettes was an unprecedented behavior whose adoption was comparatively recent, and initiated within the past 3 years by most (Hammond et al., 2021).

Prior smoking experience was also reported by about half of the participants, as it has been proven that vaping is deeply related to regular smoking (McMillen et al., 2019; Soneji et al., 2017). The majority of the participants were nuclear families and urbanites, and there were more marketing as well as peer influence. The sample was overwhelmingly male (69%) and supported the patterns of vaping prevalence seen throughout the world where more males engage in the practice (CDC, 2021).

On the emotional level, a large portion of vape users obtained high emotional suppression and internalizing/externalizing behavior problem, both of which were associated with the higher psychological distress (Gross & John, 2020; Aldao et al., 2022). They had lower scores and results in well-being engagement and emotional satisfaction, and it was connected to vaping as a coping mechanism (Seligman, 2018; Smith et al., 2023). Insensitivity to the real-life dissimilarity, impulsivity, and choice of immediate rewards were also exhibited, which is in accord with reports that nicotine use is associated with impulsiveness in behavior (Bickel et al., 2019; Stein et al., 2021).

Gender variations were evident: ladies showed more emotional and behavioral dysregulation whereas males had the tendency to hide emotions (Chaplin & Aldao, 2020; Weinberger et al., 2020). This highlights the importance of applying gender-sensitive interventions, which will be focused on emotion regulation and healthy coping processes. The educational experience brought beneficial effects on emotional control in agreement with the literature on the role of academic achievements that lead to improved coping and resilience (Fergusson et al., 2019; Meyers et al., 2022). Age and gender demonstrated minimal predictive potential impacting on emotional well-being replicating distinct past experiences (Hussain et al., 2023; Ksinan et al., 2021). Nevertheless, the history of substance use, particularly, early onset, was associated with greater emotional and behavioral issues, which confirmed previous findings (Sinha, 2020; Batool & Ahmed, 2022). The length of vaping did not make much of a difference.

To summarize, the role of emotional regulation, gender, education, and the age of the onset of vaping are critical to developing the psychological well-being of young people who use a vape. The insights are concerned with the necessity of psychosocial and educational programs which extend beyond finding discriminatory breaks in their demographics and which center upon the betterment of cognitive and emotional skills.

Conclusion

The study sought to prove emotionality and behavior of young vape users; findings indicate that many of them grapple with emotion regulation, at times opting for suppression as a strategy that ironically increases distress and reduces well-being. In comparison, the young vape users cited higher levels of emotional disturbances and behavioral problems-these may

include anxiety and impulsivity. Men were more suppressed, whereas women tended toward greater distress. The gender differences speak for the importance of developing mental health initiatives tailored to their respective hurdles. Education was another variable that surfaced as critical with many findings suggesting that higher levels of education might empower young people to develop better emotional management and stress-coping skills. The majority claimed to have actually begun vaping within the last three years, which corresponds with the time frame that e-cigarettes have been gaining popularity among youth. Fifty percent had a smoking history, which again stresses the association between vaping and smoking tobacco. Most participants came from nuclear families with parents having intermediate education, which may therefore shape the mindset of youths with regard to vaping and insight with regards to its dangers

The recent study confirmed a connection between emotional regulation and well-being. However, it approached emotional and behavioral problems affecting well-being from a different angle. Although decision-making tendencies were mentioned, they were not a major focus suggesting that they might affect well-being in a more complex manner. The importance of emotional regulation for psychological health has been established, thus, indicating support for similar findings. Generally, the study offers insight regarding the behavior and emotional make-up of young vape users, emphasizing the need for targeted work in both mental health and education, which will help them learn healthier coping behaviors and enhance their overall well-being.

Conflict of Interest No conflict of interest was present

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