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RESEARCH ARTICLE

Statistical Analysis of the Mediating Effect of Diet Habits and Its Affecting Factors on Academic Performance Among Students

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ABSTRACT

Among many factors, academic performance is affected by student dietary habits since depending on what and when a student eats, academic performance can be positively or negatively. Dietary habit plays a mediator role in affecting a student's academic performance, as it is affected by many other factors. These factors may include device usage and screen time, quality of sleep, mental health problems, health and supplementation, diet habits, substance abuse, and criminal activity. The study aims to discover the mediating effect of dietary habits combined with various aforementioned affecting factors on academic performance with overall CGPA as a measurement through statistical analysis. The older data sets from our ICPSR previous seniors were selected to undergo data fusion and cleansing before being used in this study. The variables are then identified and analyzed using SPSS Statistics v23 to produce the results. The results of this study show that eating habits mediate the relationship between academic performance with criminal activity, health, and supplement. Substance abuse, sleep quality, device usage, and screen time are also found to correlate negatively with academic performance, but are not mediated by dietary habits. Mental health problems are found to be of no significance in their hypothesized negative correlation with academic performance. This study is expected to raise the awareness among students about activities and habits that can negatively affect their academic performance, encouraging them to avoid such activities and habits.

INTRODUCTION

As society today begins to evolve, with more focus than ever on student academic performance. It is crucial to explore and study the aspects or factors that could influence a student's academic performance. Bad eating habits and eating behaviors are speculated and predicted to have a devastating impact on their cognitive function, making them unable to achieve scholastic demands. There are several published studies that show significant relationships between various factors that could be associated with a student's academic performance, including sleeping habits, drug abuse, quality of life, health, and supplementation. However, there are a limited number of studies that show that dietary habits could play an important role in affecting student academic performance. The

increase in the rate of consumption of fast food consumption among university and college students is due to the inconvenience and inaccessibility of obtaining nutritious and balanced food sources. The purpose of this research is to study these mediating effects and their affecting factors using CGPA as an outcome measure. It was speculated that dietary habits would mediate the relationship between various influencing factors and academic performance.

Problem Statement

Student academic performance has always been a top priority for all educational institutions, parents, and students. The study of factors that can affect academic performance and the mediating roles of dietary habits is important to better understand and improve students' academic performance based on these factors. Despite that, there are insufficient studies on this branch of knowledge. Further study of these issues is necessary to raise awareness among students to encourage good diet practices and habits among students to achieve better academic performance.

Dietary habits refer to how we eat, the foods we eat, and as well as the ways people obtain food. Breakfast, perhaps the most important meal, refers to any food consumed in the morning before 10 am, or the first 2 hours of being awake in the morning [1]. However, among the participants in a study conducted at the University of Saudi Arabia, only a small 34.7% have a habit of consuming breakfast daily [2].

With the advancement and widespread use of technology, smartphones, computers, and tablets became inseparable items from a student's life. The addictive potential of these devices caused students to be prone to excessive device usage and prolonged screen time. Examples of device usage include watching television, using smartphones, playing games on consoles, watching videos on Youtube on various devices, and so on. A study in Argentina with 52 universities shows that students spend about 43% of their waking time using devices [3]. The outcome indicates that a student's physical health, sleep routine, and academic performance of the student are considerably influenced by the use of the device and screen time. Improvement in all those aspects impacted is significantly associated with a shorter screen time. As people are more likely to have fast food and snacks when watching videos and movies, device usage and screen time can also affect a person's dietary habits.

Studies show that sleep is an underutilized opportunity for students to maximize academic success [4]. Lund and colleagues conducted a survey and found that many college students fall victim to sleep deprivation and unsatisfactory daytime alertness due to lack of sleep. Good sleep quality is important for our brain which controls the proper function of body organs on a daily basis [5,6]. Due to the busy schedules of students and the busy academic assessments, the sleep-wake cycles are becoming inconsistent, messy, and irregular [7]. The minor impact of inadequate sleep could lead to morning tiredness, slower reaction time than normal, poor judgment, inability to focus, excessive daytime sleepiness, and frequent daytime naps [8]. Long-term disruption of the sleep cycle negatively contributes to the development of serious chronic health problems including but not limited to cardiovascular disease, hypertension, depressive disorders, and mental distress. However, there are only a few studies to prove and support the fact that sleep quality could significantly affect student academic performance.

The use of alcohol and drugs among students in college and university appears to be relatively high. Approximately 43.6% of the participants in a study at a Nigerian university reported having consumed alcohol, and one in every three students had consumed alcohol the previous month [9,10]. Substances contained in drugs and alcohol can have adverse effects on the brain and health conditions of a person. Few studies showing a significant relevance of substance abuse for academic performance [11]. More research is needed to investigate the relationship and connection between academic performance and substance abuse to produce numerical data and enhance students' understanding of this topic.

The crime rate in US schools has remained high in numbers in recent years [12, 13], creating a nonconducive learning environment to achieve great academic success. In 2018, there were about 836,100 total theft and non-fatal violent victimizations among students aged 12 to 18 years at school and 410,200 away from school. The learning process carried out in a crime-filled environment is detrimental to the academic performance, more so if the students themselves are involved in such activities, shifting their focus away from the aspects that are truly important to them. Therefore, numerous studies have shown a negative correlation between crime activities and academic performance [14,15,16,17]. Research is needed to investigate the connection between student involvement in criminal activities and its direct and indirect negative academic consequences through mediation of dietary habits so that this serious problem can be understood better and mitigated in a suitable and effective manner.

LITERATURE REVIEW

In this section of the literature review, more than 50 relevant existing research articles are thoroughly reviewed on the relationship between academic performance and device usage and screen time, quality of sleep, health and supplementation, diet habits, mental health problems, substance abuse, and criminal activity to identify the potential measurement parameters to test in the study and to illustrate the study's conceptual framework.

Over the past few years, scholars have been investigating the association between academic performance, well-being, and sleep quality. Although there has been considerable research on sleep relationship between the quality and educational attainment or academic performance, less emphasis has been placed on how quality influences academic achievement. The findings of a study indicated that better academic performance is associated with longer sleep duration, improved sleep quality, and consistent sleep patterns. Specifically, the study revealed that extended sleep duration during the week around the corner to the final evaluation and maintaining 8 hours of sleep duration for 5 days before a final assessment was related to better academic outcomes [4]. However, a similar study shows that students with better sleep quality precede an increased psychological quality of life and higher academic performance [18]. According to a review evaluating the mutual connection between sleep quality, sleep duration, and school performance. Research has shown that sleep quality plays a pivotal role in academic performance, with insufficient sleep being linked to detrimental impacts on cognitive functions of the "executive center" of the brain, which is the prefrontal cortex. This can result in a decline in executive function and working memory. In addition, poor sleep quality reduces alertness during the day, which can impact attention and cause academic performance to suffer [19]. Another study, with similar conclusions, found that students who struggle academically tend to experience sleep-related problems. Adequate sleep quality is deemed vital to produce accurate work during waking hours and, consequently, leads to an improved quality of life. Typically, sleep quality is related to both the physical and mental well-being of a student. In addition, inadequate sleep can negatively affect academic performance [20]. Students who do not get enough sleep may feel exhausted all day, which can affect their academic performance and study quality [21].

A research study examining the relationship between sleep problems in medical students and their impact on academic performance revealed that inadequate sleep quality was associated with decreased academic performance and an increased risk of insomnia (p 0.001) [22]. Another study indicated that the use of electronic devices for less than 60 minutes before bedtime was associated with better sleep quality, while the prolonged use of electronic devices before bedtime increased the likelihood of poor academic performance by 1.28 times (P=0.020) [23]. Furthermore, the study revealed that the frequent use of electronic screens was correlated with inferior academic performance [23]. In a 2019 study examining the relationship between insomnia and academic performance. The study revealed that students who achieved a cumulative grade point average (CGPA) of 3 or higher had better sleep quality in comparison to those with a CGPA lower than 2.5.

For most people, having adequate sleep is crucial in learning, as it is believed to improve cognitive performance, focus, and learning ability [25]. Despite the general consensus on the importance of sufficient sleep for academic achievement, a study conducted on medical students in Saudi Arabia [26] suggests that it may not always be a conclusive indicator. On the contrary, another similar study involving a different group of medical students reported opposite findings, with improved sleep quality associated with increased academic achievement [27]. In another separate study conducted on another group of medical students, both academic performance and the connection between sleep quality were unable to be established despite the fact that bad quality of sleep was correlated with elevated levels of stress [28]. To explain the differences between these three studies, it is believed that the reduction in cognitive performance, focus and learning ability from the lack of sleep can sometimes be compensated for if the reason for poor sleep quality is due to more time allocation in studying, but results can vary between academic subjects, particularly between subjects with heavy logic and heavy memorization.

Sleep is a fundamental requirement for healthy operation and is essential for the development of memory, learning, decision-making, and critical thinking. In addition to its key role in helping memory consolidation and the learning process, sleep is a basic biological requirement for healthy operation of the human body, having a widespread influence on critical thinking and decision-making abilities. [21]. Getting enough sleep is essential to improve academic achievement because sleep is essential for children's cognitive and neurodevelopment [29]. Lack of sleep impairs alertness, causes attention to decline, and slows cognitive functioning [30]. Furthermore, insufficient sleep can impair the functioning of the prefrontal cortex and hippocampus, which in turn can negatively affect memory, language, creativity, as well as logical and critical reasoning abilities [30]. Inadequate sleep among adolescents attending school has become a health problem, with a significant proportion of this population experiencing difficulties in getting sufficient sleep, resulting in chronic sleep deprivation and disrupted sleep-wake cycles [31]. Research suggests that delaying school start times by an hour can provide students with more time to sleep, leading to better sustained concentration throughout the day, increased attendance, and improved academic success [32]. Students who experience insomnia are prone to report failures in final examinations and lag in their academic progress [33]. Furthermore, multivariate analysis has indicated a robust link between inadequate sleep and poor academic performance, with an adjusted odds ratio of 3.33 (95% confidence interval = 1.28-8.63) [34].

Sufficient sleep is typically defined as an average sleep of 7 to 9 hours per night. The quantity and quality of sleep are important for a person's mental and physical health [5,35,36]. Students are often stressed and under academic pressure due to heavy school work, assignments, or other issues they might be facing as adolescents [37]. Adequate sleep is important for our organs to rest, for our brain to consolidate memory, and for the refreshment of information. Our brain stores the information learned during the day and consolidates it into permanent memory when we sleep at night. The health status of the brain is essential for a student to achieve high academic performance, as they need to have a fresh and quick thinking brain to perform daily tasks in school [7]. Sleep disorders can worsen their academic performance and their health status in terms of physical and mental [5]. Students who struggle with academic performance often spend more time studying at night in an effort to improve their grades. However, many students may not realize that inadequate sleep can negatively affect their academic performance. Furthermore, students with poor academic performance tend to develop unhealthy sleep habits. This results in a harmful cycle in which inadequate sleep and weakened mental health worsen academic challenges, leading to a continuous chain of unfavorable outcomes [6].

In 2019, a research study suggested that certain eating habits or dietary patterns might be associated with improved academic performance among students [38]. The Department of Nutrition and Public Health at Merrimack College conducted a study that found a positive correlation between academic

performance, diet quality and food security in universities that offer free school meals to their students. Since both diet quality and academic performance were positively affected as a result of this study, it is not yet known whether the increase in academic performance was a direct effect due to free school meals provided, or indirectly affected by the increase in diet quality [39]. A study carried out by the Department of Research Methods and Diagnosis in Education at the University of Granada discovered a correlation between academic stress, poor dietary habits, and unhealthy body mass index (BMI). In particular, the study noted that low adherence to the Mediterranean diet (MD) was associated with academic stress and an unhealthy BMI [40]. Breakfast is an important part of a person's dietary habits, as it is the first meal a person eats during the day. The Department of Nursing at Woosong University conducted a study among school-aged students to study the influence on academic performance [41]. Their results showed who students that had breakfast achieved significantly better academic performance than the students that did not have breakfast. With this result, it can be said that eating breakfast positively affects a student's academic performance. A study conducted in Tehran, Iran, investigated the relationship between breakfast habits, nutritional status, and academic performance among primary school students. The results were different from those of the previous study mentioned, as they did not find a significant association between breakfast and academic performance ($p=0.73$). With this result, another saying can be made that eating breakfast does not impact the academic performance of a student. The ambiguity and contradictory nature of these two studies indicate that more studies are needed to establish a relationship between the factors mentioned above.

Breakfast, often regarded as the most crucial meal, breaks overnight as the name suggests. It is a significant source of nutrition during puberty and has a significant impact on psychological and cognitive abilities, according to the general consensus around the world. At the same time, to improve their student's academic performance and health condition, more emphasis should be placed on breakfast quality [43]. Encourage students to eat well because doing so can help them in developing healthy habits that can improve their focus and academic performance [44]. Many studies have found that vitamin D can have an impact on both brain function and brain growth [45,46]. Insufficient vitamin A may negatively affect academic achievement in preschoolers and have negative economic consequences for society, according to research [47]. Meanwhile, vitamin C supplements can reduce anxiety and enhance academic performance by increasing cortisol levels in response to stress. This is because vitamin C has been found to be inversely correlated with serum cortisol during stressful tests [48].

A research study conducted at a university in Malaysia found that a significant percentage of medical students, approximately 73.5%, eat fast food more than twice a week. Additionally, research revealed that a considerable proportion of students have a tendency to miss meals. Specifically, 33.5% of the students reported having three meals per day based on a 24-hour food recall, while 49.8% of the students only consumed two meals. However, supper remains high in popularity among these students who, there are (78.8%) of students tend to eat supper while breakfast was the least consumed (18.7%) [3]. The result of these studies shows that students have not paid enough attention to the importance of proper diet habits. There have been some studies that have previously shown that unhealthy eating habits can affect a person's mental health and can be associated with the prevalence of stress in different populations [2].

Lance Lochner conducted a study in 2020 on the relationship between education and crime [14]. According to the study, the economic theory that there exists a negative correlation between educational attainment and criminal activity. The study results had shown that property crime decreased significantly with educational attainment, and the experience of imprisonment during the late adolescent years also negatively impacts educational attainment. This suggests that educational level and criminal activity seem to affect one another, where a high educational level corresponds to lower criminal activity and vice versa. In another study by Aaron Gottlieb and Robert Wilson, they

found who a student that performs poorer in academic achievement had prior experiences of police arrest, police contact, imprisonment, and court involvement, further establishing the relationship between academic performance and criminal activities [15]. On the other hand, a study found that physical aggression, bullying, victimization by peers, and general threats can potentially longitudinally affect student academic achievement and crime participation among primary and secondary school students [16]. A research study conducted in 2019 by Andrew Bacher-Hicks, Stephen B. Billings & David J. Deming aimed to investigate the lasting impacts of school suspensions on criminal behavior among adults. The research indicated that people who go to school with higher rates are 15% to 20% most likely to be arrested and imprisoned in adulthood, resulting in adverse consequences for their academic achievements [17]. The results of both studies show how academic performances and criminal activity are affected in a similar manner by the same factors, but do not tell whether academic performance and participation in crime involvement exerts a compounding impact on the seriousness of the other; therefore, more studies need to be conducted in order to establish this relationship.

Depression or depressive disorders are associated with loss of interest, lack of enthusiasm, motivation, and enjoyment of performing tasks in a person's daily life, which includes learning and studying in the case of students. From this definition, in a study it is observed and concluded that depression or depressive disorders will negatively impact student academic performance [49]. In a joint study by the Department of Leisure Sports, Kangwon National University and the Department of Physical Education, Seoul National University, it was found that students with high levels of depression suffered negative impacts on their academic performance through poorer peer relationships as a key mediator [25]. A collaborative study by the Freeman Spogli Institute for International Studies at Stanford University, Groton School, Groton, and the Institute of Sociology at Academia Sinica in Taipei revealed that students who perform better in mathematics tend to have fewer depressive symptoms and are at a lower risk of developing them [49]. These findings show that depression together with depressive symptoms and academic achievement may not simply be a one-way causal relationship, but rather a two-way causative relationship where either aspect can potentially affect the other. Depressive symptoms cause a student to have low academic achievements, or low academic achievements leading to the development of depressive symptoms.

Substance abuse refers to the excessive use of alcohol and harmful illegal drugs. Examples of commonly used drugs are cocaine, narcotics, and marijuana. Research studies have demonstrated that substance abuse, including alcohol and illegal drugs, can harm the brain, resulting in a decline in academic performance [9]. A study by the Romanian Medical University found that students who consume a large amount of alcohol tend to engage in risky behaviors such as smoking, drug use, and skipping or cutting classes [11,36]. This research information will contribute to raising public awareness.

According to a study conducted in 2022, spending excessive amounts of time watching TV can lead to wasted time and difficulty focusing, which ultimately results in poorer academic performance and negative effects on academic progress [24]. According to the findings of a specific study, short videos can have a noteworthy impact on students' final exam performance, increasing their scores by approximately 9.0%[50]. Smartphone use showed an adverse association with both sleep quality and academic performance, while excessive internet gaming showed a negative correlation with physical activity and psychological well-being [18]. A study revealed that there is a correlation between student academic performance and their access to instructional videos, demonstrating that educational videos can be used to efficiently improve learning [50].

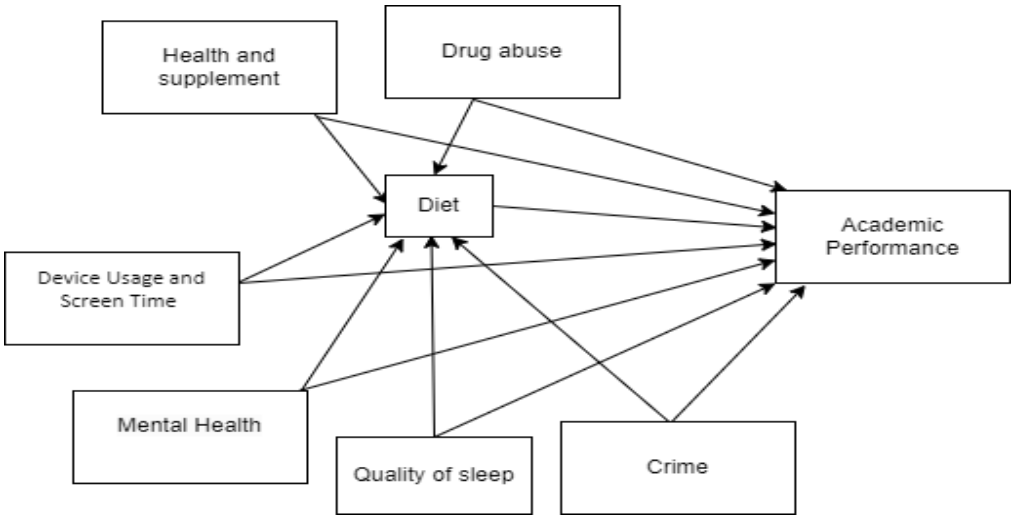

Figure 1. The research models.

Research Hypothesis

H1: Drug abuse is negatively with academic performance.

H2: Diet mediates the relationship between drug abuse and academic performance.

H3: Health and supplementation are positively with academic performance.

H4: Diet mediates the relationship between health and supplementation and academic performance.

H5: device usage and screen time correlate positively with academic performance.

H6: Diet mediates the relationship between device use, screen time and academic performance.

H7: Mental health problems correlate negatively with academic performance.

H8: The diet mediates the relationship between mental health and academic performance.

H9: Sleep quality correlates positively with academic performance.

H10: Diet mediates the relationship between sleep quality and academic performance.

H11: Crime correlates negatively with academic performance.

H12: Diet mediates the relationship between crime and academic performance.

RESEARCH METHODOLOGY

The Interuniversity Consortium for Political and Social Research (ICPSR) is a well-known international consortium that provides more than 250,000 dataset files for research in the social sciences. Researchers can access free sample files, which are publicly available for download, and use them to clean, organize, and analyze data for research in the social and behavioral sciences. Two specific datasets are used in this present study, "Longitudinal study of crime committed, academic performance, job classification, health condition and demographic that affect the graduation rate among young adults in the USA", and "Impacts of life management on academic performance – A longitudinal study among young adults in the USA." The first questionnaire is distributed to 1,879 students while the second questionnaire is distributed to 3,015 students (bachelor degree, 1994-2001) and composed of a total number of 4,894 responses for the whole cross-section dataset.

This research employs two datasets from senior students (DS8 - In-Home data, 16 - education data, 17 - graduation data), which are merged using SPSS and subsequently cleaned. The final dataset

includes 16 variables, as outlined in Table 1, with a total of 1,879 cases. The primary focus of this study is the cumulative GPA (CGPA), which is influenced by 13 independent variables. There are a total of 1 variable in the category of health and supplementation, 1 variable in substance abuse, 3 variables in device usage and screen time, 1 variable in mental health problems, 3 variables in criminal activities, 2 variables in quality of sleep, 2 variables in dietary habits, and 1 in academic performance. This study analyzed and cleaned 13 selected variables that are classified into 7 major categories, which are device usage and screen time, sleep quality, health supplements, dietary habits, mental health issues, substance abuse, and criminal activity.

The process outlined in Figure 1 is used to process the combined datasets. If the data set contains more than 10 variables, missing data will be removed, and any variable with over 30% missing values of more than 30% will be removed. After data cleaning, there were 1,879 cases remaining. Specific considerations will be used to replace missing values in various variables. For example, the missing value of the GPA variable will be replaced with the mean value. The original data sets can be found on the ICPSR Web pages.

Once the data set has been converted, the connection between the dependent variable, academic performance, and the independent variables, including device usage and screen time, sleep quality, health supplements, diet habits, mental health issues, substance abuse, and criminal activity, is analyzed using SPSS bivariate analysis (Pearson correlation). The findings are presented in Table 2, following the method used in earlier research where only relevant variables are included in the table. The table is sorted according to Pearson's correlation. After the SPSS bivariate analysis (Pearson correlation) is performed, mediation analysis will be performed with the results shown in Table 3.

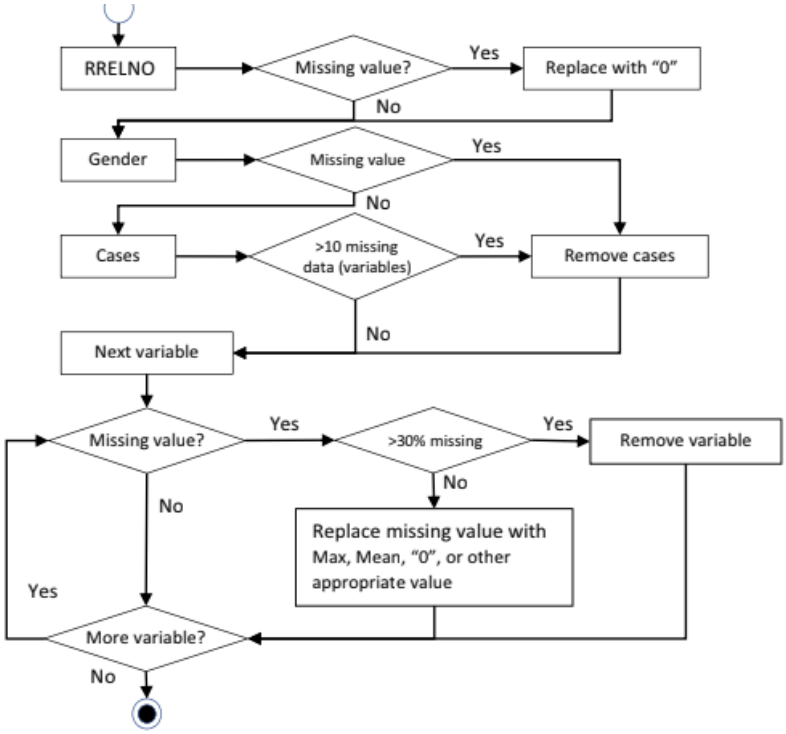

Figure 2. Data set cleaning and transformation process.

Table 1. Variables reference

Category	VARIABLE ID	Variable Label	QUESTIONNAIRE QUESTION/ITEM
Independent Variables			

Drug Abuse IV1	H3TO120	IV1a.: S28Q120 since June 1995 shot drugs-W3	Since June 1995, have you injected (shot up with a needle) any illegal drug, such as heroin or cocaine
Health and Supplement IV2	H3GH20	IV2a.: S9Q20 Vitamins or minerals last month-W3	In the last month, have you taken any vitamins or minerals?
Device Usage and Screen Time IV3	H3DA3	IV3a.: S33Q3 Watch videos-W3	In the past seven days, how many times did you watch a movie, play video or computer games, or use a computer for surfing the Web, exchanging email, or participating in a chat room?
	H3DA5	IV3b.: S33Q5 Hours and week play computer games-W3	On the average, how many hours a week do you spend playing video or computer games, or using a computer for something other than school work?
	H3DA6	IV3c.: S33Q6 Watch TV-W3	In the past seven days, how many times did you watch television?
Mental Health IV4	H3ID15	IV4a.: S11Q15 Ever been diagnosed with depression-W3	Have you ever been diagnosed with depression?
Quality of Sleep IV5	H3GH11T	IV5a.: S9Q11 AM or PM you wake up-W3	On days when you go to work, school, or similar activities, what time do you usually wake up? [Indicate AM or PM.]
	H3GH13H	IV5b.: S9Q13 Hour usually wakes up and sleeps in-W3	On days you don't have to get up at a certain time, what time do you usually get up? Hour.
Crime IV6	H3DS5	IV6a.: S26Q5 12 months, often sell drugs-W3	In the past 12 months, how often did you sell marijuana or other drugs?
	H3DS7	IV6b.: S26Q7 12 months, often part physicalS fight and group-W3	In the past 12 months, how often did you take part in a physical fight where a group of your friends was against another group?
	H3DS13	IV6c.: S26Q13 12 months, ever belonged named gang-W3	Have you ever belonged to a named gang?
Mediator			
Diet M1	H3GH18	M1a.: S9Q18 Days ate fast food last 7 days-2W3	On how many of the past seven days did you eat food from a fastfood place, McDonalds, Kentucky Fried Chicken, Pizza Hut, Taco Bell, or a local fastfood restaurant?
Diet M2	H3GH19	M1b.: S9Q19 Days ate breakfast last 7 days-W3	On how many of the past seven days did you eat breakfast--that is, a meal within an hour of getting up?
Dependent Variable			
Academic Performance DV1	EAOGPAC	DV1a.: Cumulative GPA across all year	Overall GPA for all courses taken in each year (EAOGPA1-6) and cumulatively (EAOGPAC).

ANALYSIS, RESULTS, AND DISCUSSIONS

Preliminary Analysis

The descriptive statistics and correlations between measures are reported in Table 2.

Table 2. Scale means, standard deviations, reliability coefficients and correlations (N = 1879).

Variable	M	SD	1	2	3	4	5	6	7
1.AP	2.7289	.68866	-				.		
2.DT	.8313	.92115	.203**	-					
3.DA	.0122	.10999	-.056*	.020	-				
4.HS	.4497	.49760	.111**	.004	.006	-			
5.LH	14.6408	11.11152	-.217**	.003	.000	-.012	-		
6.MH	.1032	.30436	.027	.051*	.089**	.059*	-.005	-	
7.QS	9.9186	2.44389	.058*	-.034	.008	-.016	-.044	-.024	-
8.CM	.3800	.84555	-.170**	.038	.122*	.001	.034	.042	-.064**

Note: AP = Academic Performance; DT = Dietary Habits; DA = Drug Abuse; HS = Health and Supplement; LH = device usage and screen time ; MH = Mental Health; QS = Quality of Sleep; CM = Crime. Results based on 1,879 bootstrap samples; * $p < 0.05$; ** $p < 0.01$.

Mediation Analyses

To investigate whether dietary habits (that is, days ate fast food last 7 days and days ate breakfast last 7 days) play a significant role in the relationships between each identified predictor factor and academic performance (that is, cumulative GPA throughout the year), we performed mediation analyses (see Table 2).

Table 3. Unstandardized direct and indirect effects with bootstrap 95% confidence interval for mediation analyses.

Predictor	Mediator	Dependent Variable	Direct effect	Significance (p value)	Indirect Effect (95% CI)
IV1a	M1	CGPA	-.3789*	.0080	.0280(-.0149,.0731)
	M2		-.3022*	.0344	-.0487(-.0864,-.0144)
IV1	M		-.3251*	.0216	-.0259(-.0778,.0254)
IV2a	M1	CGPA	.1307*	.0000	.0228(.0124,.0350)
	M2		.1190*	.0002	.0345(.0217,.0501)
IV2	M		.1020*	.0014	.0516(.0355,.0689)
IV3a	M1	CGPA	-.0309*	.0000	-.0031(-.0054,-.0012)
	M2		-.0342*	.0000	.0002(-.0020,.0022)
IV3b	M1	CGPA	-.0085*	.0000	-.0007(-.0013,-.0002)
	M2		-.0093*	.0000	.0001(-.0005,.0009)
IV3c	M1	CGPA	-.1127*	.0000	-.0040(-.0063,-.0020)
	M2		-.1139*	.0000	-.0028(-.0050,-.0009)
IV3	M		-.0145*	.0000	-.0009(-.0016,.0003)
IV4a	M1	CGPA	.0485	.3484	.0118(-.0034,.0288)
	M2		.0557	.2801	.0046(-.0124,.0217)
IV4	M		.0468	.3608	.0135(-.0077,.0363)
IV5a	M1	CGPA	-.2362*	.0001	-.0133(-.0328,.0042)
	M2		-.2297*	.0002	-.0198(-.0402,-.0015)
IV5b	M1	CGPA	.0168*	.0081	.0019(.0000,.0041)
	M2		.0179*	.0047	.0008(-.0011,.0027)
IV5	M		.0145*	.0230	.0020(-.0006,.0046)

IV6a	M1	CGPA	-.1164*	.0000	-.0082(-.0179,.0003)
	M2		-.1213*	.0000	-.0033(-.0112,.0039)
IV6b	M1	CGPA	-.2455*	.0000	-.0219(-.0384,-.0083)
	M2		-.2521*	.0000	-.0153(-.0302,-.0027)
IV6c	M1	CGPA	-.1530*	.0010	-.0189(-.0353,-.0054)
	M2		-.1675*	.0003	-.0044(-.0197,.0105)
IV6	M		-.1253*	.0000	-.0133(-.0213,-.0063)

Note: M1= DAYS ATE FAST FOOD LAST 7 DAYS-W3; M2= DAYS ATE BREAKFAST LAST 7 DAYS-W3; IV1a= Short drug since 95; IV2a= Vitamin or mineral last month; IV3a= Watch video; IV3b= Hrs/Wk Play computer games; IV3c= Watch TV; IV4a= Ever Been Dx With Depression; IV5a= AM OR PM You Wake up; IV5b= Hour usually wake up/sleep in; IV6a= MO.OFT SELL DRUG; IV6b= MO. OFT Part Phys Fight/-Grp; IV6c= MO.Ever Belonged Named Gang. Results based on 1,879 bootstrap samples; CI—bias-corrected 95% confidence interval for the indirect effects. * $p < 0.05$.

Results and Discussions

H1: Drug abuse is negatively with academic performance.

Table 2 shows a statistically significant negative correlation ($r = -0.056$, $p = 0.0216 < 0.05$) between substance abuse and academic performance, leading to the acceptance of hypothesis 1. This could be due to the fact that the harmful substances in drugs interfere with normal human's brain function, causing them to be unable to focus, learn, and retain memory, negatively impacting their academic performance. The result of this study is in agreement with the findings of a research conducted by Adeoti et al., 2021 [9], which also revealed a negative correlation between academic performance and substance abuse. It is worth noting that in the research, substance abuse is measured in alcohol consumption, whereas in our research, it is measured in the injection of drugs. In Table 3 it is observed that in this dataset, substance abuse is negatively with academic performance with a direct effect of -.3251, meaning that academic performance worsens accordingly with the degree of drug abuse practiced by the student. This highlights the need for educational institutions, parents, and guardians to adequately educate students and young people about the detrimental impact of substance abuse on academic performance. This will help increase awareness and discourage from engaging in such behavior.

H2: Diet mediates the relationship between drug abuse and academic performance.

The mediation analysis suggests that there is no mediating role for dietary habits in the relationship between drug abuse and academic performance. The negative correlation between drug abuse and academic performance is not influenced by dietary habits, with a mediating effect of -.0259 and a 95% CI of [-.0778, .0254]. Therefore, hypothesis H2 is rejected. However, if we look into the individual mediating variables (M1, M2) that make up the mediator M, the consumption of fast foods in the past 7 days does not mediate the relationship between drug abuse and academic performance (indirect effect = .0280, 95% CI = [-.0149,.0731]), while the consumption of breakfast in the past 7 days do mediate the relationship between drug abuse and academic performance (indirect effect = -.0487, 95% CI = [-.0864,-.0144]). This may be due to substance abuse affecting a person's appetite to consume breakfast on a regular basis, causing them to skip breakfast, or potentially disrupting a person's circadian rhythm to the point of missing the timeframe of consuming breakfast. The latter effect may be due to the same contributing factor that caused the high rate of class absences and class skipping as mentioned in a previous study conducted by Ajayi et al., 2019, and Nasui et al., 2021 [11,36]. The lack of mediation effect of fast food intake in the connection between drug abuse and academic performance could be due to the influence of other factors on students' dietary habits, such as their location, financial situation, and food availability, which could impact all students similarly, regardless of their participation in substance abuse. Therefore, it may be the case that academic

performance is negatively affected by both substance abuse and diet habits, independently of each other.

H3: Health and supplementation correlate positively with academic performance.

According to Table 2, the sig. for the positive correlation between health and supplement and academic performance is significant ($r = 0.111$, $p = .0014 < 0.05$), therefore, H3 is accepted. This could be due to the fact that the consumed vitamins and minerals consumed promote healthy growth of students' brains enabling them to learn and perform well in an academic setting, as mentioned in previous studies conducted by AlZahrani and Oommen, 2023 and Alfayyadh, 2020 [45,46]. Similar to the studies conducted by Tan et al., 2023 and Kamal, 2022 [47,48], our findings are consistent with the notion that deficiencies in vitamins (A, D, and C) can lead to lower academic performance among students, while adequate consumption of these vitamins can result in better academic outcomes. It is worth noting that in both the mentioned studies and the current study, health and supplement consumption are measured solely by vitamin and minerals consumption. In Table 3 it is observed that in this dataset, health and supplementation correlate positively with academic performance with a direct effect of.1020, which means that academic performance improves accordingly with student consumption of health supplements by the student. This encourages financially capable parents and guardians to support their young people's academic journey with sufficient health supplements such as vitamins and minerals in order to increase their academic performance.

H4: Diet mediates the relationship between health and supplementation and academic performance.

The mediation analysis reveals that there is a mediating effect of dietary habits on the positive correlation between health supplements and academic performance. The indirect effect is measured at .0516 with a 95% CI of [.0355,.0689]. Therefore, the results show that the relationship between health supplements and academic performance is influenced by diet habits, and hypothesis H4 is supported. This phenomenon can perhaps be explained by students with a good habit of health and supplementation generally having good health consciousness, and hence are also more likely to practice healthy eating habits, resulting in subsequent high academic performance. However, students without a good habit of health and supplementation to begin with generally have poor health awareness and therefore are less likely to practice healthy eating habits, resulting in subsequent poor academic performance.

H5: Device usage and screen time correlate negatively with academic performance.

According to Table 2, the sig. for the negative correlation between device usage and screen time and academic performance is significant ($r = 0.217$, $p = .0000 < 0.05$), therefore H5 is accepted. This may be due to the fact that device usage takes away the spare time that a student can instead use on studying and serves as a deterrent to academic performance since a student that indulges in these entertainment activities will end up with less spare time to spend on academic activities. Compared to the research conducted by Dalia Osman, 2022 and C. Kwok, 2021 [24,18], the results are similar and consistent with our findings, where device usage and screen time factors such as watching television and playing computer games negatively affect academic performance. The results contradict The findings of Zhu et al. (2022) findings [50], which found a positive correlation between watching videos and academic performance. It should be noted that the videos being studied in the last research [50] include educational short videos that may supplement a student's learning rather than hinder it, making it different from this current study and the other 2 studies mentioned [24,18]. Table 3 shows that in this dataset, device usage and screen time are negatively with academic performance with a direct effect of -.0145, meaning that academic performance worsens accordingly with the indulgence in device usage and screen time by the student. This encourages parents and

guardians to supervise the usage and screen time so that they may not negatively affect their academic performance.

H6: Diet mediates the relationship between device use, screen time and academic performance.

Based on the mediation analysis performed in Table 3, the indirect effect of the mediating effects of diet habits on the negative correlation between device use and screen time and academic performance is -.0009, 95% CI = [-.0016,.0003]. Therefore, diet habits in general do not mediate the relationship between device usage, screen time and academic performance, so H6 is rejected. However, if we look at the individual mediating variables (M1, M2) that make up mediator M and the individual predictor variables that make up the independent variable (IV3), fast food consumption of fast foods in the past 7 days mediates the relationship between watching videos and academic performance (indirect effect = -.0031, 95% CI = [-.0054, -.0012]) and the relationship between hours per week playing computer games and academic performance (indirect effect = -.0007, 95% CI = [-.0013,-.0002]). This could be because students who have already developed a device usage addiction may also tend to prioritize fast food over breakfast due to their reluctance to spend time and prepare a proper breakfast. As a result, both their poor dietary patterns and adverse practices of device usage and screen time can adversely affect their academic performance. Meanwhile, the consumption of breakfast in the last 7 days does not mediate either of the relationships between watching videos and academic performance (indirect effect = .0002, 95% CI = [-.0020,.0022]) or hours per week of playing computer games and academic performance (indirect effect = .0001, 95% CI = [-.0005,.0009]). The indirect value of this result may be attributed to the possibility that the negative impact of device usage and screen time on academic performance can be offset by the potential positive effect of breakfast on academic performance, resulting in a rare occurrence of a positive correlation between the two factors. The correlation between television viewing and academic performance is mediated by fast food (indirect effect = -.0040, 95% CI = [-.0063,-.0020]) or breakfast in the past 7 days (indirect effect = -.0028, 95% CI = [-.0050,-.0009]). This might be due to the fact that despite television being a source of distraction by itself, fast-food advertisements by most fast-food franchises are also commonly seen broadcast through the television as a medium, enticing television viewers to practice bad eating habits more so than other mediums. Both roles have a cumulative negative impact on a student's academic performance.

H7: Mental health problems are negatively with academic performance.

According to Table 2, the sig. for the negative correlation between device usage and screen time and academic performance is not significant ($r = .027$, $p = .3608 > 0.05$), and therefore H7 is rejected. This may be because mental health problems can also positively affect some students' academic performance while negatively affecting some other students' academic performance based on the difference in the mental health problem type, severity, pathological presentation, environment, and support provided which are not investigated in this study. Depressed students may have less enthusiasm for studying, but some of them may also be less enthusiastic about entertainment activities that serve as a distraction or academic hindrance for the average student, canceling out the effects of one another. This study focused exclusively on depression as a metric for mental health issues, as the available data did not contain information about other conditions such as anxiety, autism, ADHD, communication disorders, etc. Unlike previous research studies [49,25] that found a negative correlation between mental health problems and academic performance, our study did not produce statistically significant results through Pearson's correlation analysis. Therefore, it is challenging to make direct comparisons. The limitations of these findings imply that more research is needed to explore the connection between mental health issues and academic performance.

H8: The diet mediates the relationship between mental health and academic performance.

The mediation analysis shows that the negative correlation between mental health and academic performance is not mediated by dietary habits, since the indirect effect of the mediating effects of dietary habits is not statistically significant. Specifically, the indirect effect is .0135 with a 95% CI of [-.0077,.0363], which indicates that dietary habits do not play a mediating role in the relationship between mental health and academic performance. Therefore, hypothesis H8 is rejected. This may be because mental health problems may affect a person's dietary habits in both directions depending on many other unmeasured factors such as supervision, support, resource availability, presentation, and severity. For example, depression may cause a person to binge eat [51] or the other way around, resulting in a drastic loss of appetite [52]. The variability in the impact of mental health problems on eating habits has posed challenges in investigating the indirect influence of mental health on academic performance through the mediating role of dietary habits.

H9: Sleep quality correlates positively with academic performance.

The positive correlation between academic performance and sleep quality is statistically significant according to Table 2 ($r = .058$, $p = .0230 < 0.05$), indicating that H9 is accepted. This may be due to the fact that adequate sleep improves clarity, attention span, and the ability to focus and concentrate in the classroom, therefore improving learning outcomes. The results of our study appear to be contradictory to the findings of a previous study [26], which discovered a negative correlation between sleep quality and academic performance. However, the result of our study is consistent with several other studies [4, 18-24, 29, 32, 33] that discovered a positive relationship between sleep quality and academic performance. This discrepancy in results may be partially explained, considering that some students willingly sacrifice sleep time for academic purposes, such as studying and completing homework or assignments, therefore partially canceling out the effect. However, this explanation is only reflected in the short-term coursework and exam achievement of the student that utilizes knowledge that a student has already learned beforehand. The general prediction that lack of sleep affects a student's learning ability to acquire new knowledge in the classroom leading to lower academic performance is still supported by this study and the others mentioned above. Table 3 shows that in this dataset, quality of sleep correlates positively with academic performance with a direct effect of .0145, meaning that academic performance improves accordingly with the increase in sleep quality by the student. This encourages students to manage their time in a healthy and balanced manner and not to sacrifice too much sleep to prevent negative academic consequences.

H10: Diet mediates the relationship between sleep quality and academic performance.

Mediation analysis in Table 3 shows that diet habits have a negligible indirect effect as a mediator factor in the positive relationship between academic performance and sleep quality, with an effect size of.0020 and a 95% confidence interval ranging from -.0006 to.0046. Therefore, it can be concluded that dietary habits do not typically mediate the link between sleep quality and academic performance, leading to the rejection of hypothesis H10. However, if we examine the individual mediating variables (M1, M2) that make up the mediator M and the individual predictor variables that make up the independent variable (IV5), fast food consumption in the past 7 days mediates the relationship between the hours a student usually wakes up and sleep in and academic performance (indirect effect = .0019, 95% CI = [.0000,.0041]) but does not mediate the relationship between AM/PM a student wakes up and academic performance (indirect effect = -.0133, 95% CI = [-.0328,.0042]). Meanwhile, the consumption of breakfast in the last 7 days does not mediate the relationship between the hours a student usually wakes up and sleeps in and academic performance (indirect effect = .0008, 95% CI = [-.0011,.0027]), but mediates the relationship between AM/PM a student wakes up and academic performance (indirect effect = -.0198, 95% CI = [-.0402,-.0015]). These observations can be explained when we consider that students who wake up later might choose to skip breakfast or already exceed the timeframe for breakfast. These students may not have

a choice but to opt for fast food as their meal choice as there might be no other food available at the time of waking up. In such cases, sleep quality is improved but at the expense of diet quality. Improved sleep quality may positively affect academic performance, but reduced diet quality also negatively affects it simultaneously, which may be the possible reason why the lower limit confidence interval is just very slightly negative in the overall indirect effect (-.0006).

H11: Crime correlates negatively with academic performance.

According to Table 2, the sig. for the negative correlation (-.1253) between crime and academic performance is negative is significant ($r = -0.170$, $p = .0000 < 0.05$), and therefore H11 is accepted. This may be due to the fact that students involved in criminal activities most often have bad peer influences and negative mental connotations toward schooling and education in general, discouraging them from performing in academics and encouraging disruptive behaviors. The finding is consistent with previous research [14-17] that also demonstrated a negative association between crime and academic performance. However, one of the studies [14] measured academic performance in terms of educational attainment, while the present study evaluated academic performance as the overall cumulative grade point average across all years. Table 3 shows that in this dataset, crime is negatively with academic performance with a direct effect of -.1253, meaning that academic performance worsens accordingly with the increase in student crime involvement of the student. This facilitates the need for educational bodies, parents, and guardians to correctly educate students and the youth regarding the negative effects of crime involvement on academic performance to raise awareness and keep them away from it.

H12: Diet mediates the relationship between crime and academic performance.

According to the results of the mediation analysis presented in Table 3, it can be inferred that the relationship between crime and academic performance is indirectly influenced by dietary habits, as the estimated indirect effect is calculated to be -.0133 and the 95% confidence interval ranges from -.0213 to -.0063. Therefore, dietary habits in general mediate the relationship between crime and supplementation and academic performance, so H12 is accepted. This may be due to the fact that students involved in criminal activities may feel that practicing healthy eating habits does not go well with their delinquent acts and chooses to practice a diet style comparable to their delinquent social peers, which is unlikely to be healthy. Based on this explanation of one bad choice leading to another, it is expected that students with involvement in crime will not prioritize a healthy diet such as breakfast and instead, unhealthy choices like fast food will be preferred due to their compatibility with the newfound sense of identity they get from their irrational acts. The compounding effect of these bad eating habits on their studies facilitates the worsening of their academic performance. The same negative peer pressure that prevented such students from studying or performing well in classes can also simultaneously encourage the same students to participate in bad unhealthy habits, ranging from vaping, substance abuse, and even eating habits, which is the mediator being studied.

CONCLUSIONS

The study examined how students' dietary habits are related to their academic performance and also investigated how dietary habits might mediate the relationship between academic performance and different factors such as device usage and screen time, quality of sleep, health and supplementation, substance abuse, and criminal activity. According to the results analyzed, we confidently believe that adequate health supplementation and avoidance of criminal activity are essential to encourage students' eating habits towards a direction that is beneficial to their academic performance. Improvement in sleep quality, avoidance of substance abuse, reduction in device usage, and screen time may also be beneficial to student academic performance despite only some of their subcategorical variables positively encouraging a student's dietary habits toward a positive academic positive manner. The study is unable to establish a significant relationship between mental health

problems and academic performance. This does not imply that students suffering from mental health problems are fair and, on a level, competing field with normal students in an academic setting, as many other aspects of their academic life are still negatively affected by their illness, such as social, communication, self-development, and many more. Continuous support should still be provided to these students to support them in their journey to obtain their rightful education.

The studies and research conducted focus only on one group of students with mostly overlapping subjects and modules from the same educational institution. To obtain more findings, more data and analysis have to be collected from other different universities across different nations. The current study cannot fully, completely, and accurately measure and represent each predictor category using enough parameters due to the limitations of the data set, and more independent variables (IV) related to the same category should be collected, merged, cleansed, and analyzed to provide a clearer picture of the relationships. Further studies on this proposed research can be extended and continued by conducting the analysis of multiple independent variables using this proposed framework.

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