



Educational big data mining: Mediation of academic performance in crime among digital age young adults

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ABSTRACT

The connection between academic performance and crime has been proven in many studies, but there is a lack of recent literature documenting academic performance as a mediator between predictors and crime, especially in a large population that has grown up in the digital age of which the high frequency of communication exchange differentiates it from previous times. The present study aims to discover the mediating role of academic performance in the connections between each predictor (the Internet usage, biological sex, duration of sleep, fast food intake, medical history, alternate drug use, and illegal drug use) and crime using a large data set from the national longitudinal study of adolescent to adult health (>90,000 sample size). The bivariate correlation between each predictor and crime is presented, as well as the direct and indirect effects for each predictor on crime through academic performance as the mediator. The results highlighted that there is a significant relationship between the Internet usage with crime, a negative correlation of academic performance with crime and positive correlations of

fast food intake, alternative medicine use, and illegal drug use with crime. In terms of mediation analyses, academic performance mediated the relationship between all the predictors (except for duration of sleep) and crime. Results may aid education policy makers in deterring crime in the digital age by improving academic performance while targeting its predictors.

Keywords: academic performance, crime, gender, drugs, sleep, health, mediation analysis, digital age

INTRODUCTION

Crime is ever present in every civilization and is a key factor in the socio-economic development of a civilization (Jonathan et al., 2021). Crime-infested cities often suffer negative impacts in their economies as the reluctance of both firm entry and foreign investment increases due to safety and stability concerns by locals and foreigners. Individuals and their relatives may also suffer from emotional and psychological disturbances as a result of exposure to crime. On the contrary, actions taken on corporations involved with criminal activity or organizations have been observed to improve the local economy in both firm performance and investment value (Calamunci & Drago, 2020). During times when information travels fast across the globe as accessibility to technologies such as email, smart phones, social media, also increases. The improvements to the technologies such as instant messaging, the Internet wireless connection, and mobile phones, the daily lives of people have adapted to its convenience, and especially so in education, where students are able to absorb information from an international, interconnected repository, the World Wide Web, and even mobile learning (Khairunesa et al., 2022; Nurliyana et al., 2022). At its infancy, regulation was not available for this novel technology. It is unthinkable that crime may have responded differently to adopting this revolutionary communication technology compared to other advances in the past, which requires attention of all parties.

Efforts to deter crime have been successful in the United States (USA), as evidenced by the Pew Research Center analysis (Gramlich, 2020) showing that violent and property victimization have been on a general downward trend since 1993. At the beginning of the COVID-19 pandemic, various major news outlets also reported a decrease in crime determined by a reduction in 911 police call volume (Boman & Gallupe, 2020). However, contradictory findings were presented by Ashby (2020) in which the pre-pandemic and initial pandemic crime rates did not show significant differences. Later in the pandemic, certain property crimes such as burglary and grand larceny may have been displaced from residential to non-residential areas in New York City, and while certain violent crimes have seen a decrease, murder and shooting incidents saw no change (Koppel et al., 2022). Additionally, a statistically significant increase in violent crime in urban areas was shown in the report of the national crime victimization survey 2021 (Thompson & Tapp, 2022). Social media and other communications technologies played a large role during the pandemic years, with the prevalence of lockdown measures. However, considering the different results on how crime has developed during the pandemic, there may be a research gap on the impact of public health on crime, where public health may be related to the use of communication technology.

Additionally, rising crime rates can have a negative impact on the well-being of individuals, as they can feel insecure in their own localities, resulting in reduced social bonding and community involvement (Cordeiro et al., 2020). Furthermore, research by Zhang et al. (2021) suggests that such an increase in crime rates can also discourage tourism, making affected neighborhoods appear less secure (Fourie et al., 2020; Ozascilar & Mawby, 2023). Consequently, this can have adverse effects on the economy as potential investors may be hesitant to invest in high-crime areas. Furthermore, the cost of law enforcement and the criminal justice system can be a significant financial burden on governments (Hunt et al., 2019). Therefore, reducing crime rates is essential not only for the safety and well-being of citizens but also for the overall economic and social health of society in the competitive digital age. It is important for governments to continue to invest in crime prevention measures and prioritize their research to ensure the safety and prosperity of their citizens. A focus on crime prevention over law enforcement may also see the benefit of saving costs that can be redirected to advancing technology.

Extensive literature is available on the direct negative correlation between academic performance and crime at various levels of education such as preschool (García et al., 2019), secondary school (Eren et al., 2022; Huttunen et al., 2023), tertiary school (Gleditsch et al., 2022), and in general (Ahmed et al., 2019). Furthermore,

recent studies also investigated links between gender (Benson & Harbinson, 2020), medical history (Tung et al., 2019), illegal drug use (Dave et al., 2021), and crime. The objective of this study is to provide evidence or lack of such regarding the mediating role of academic performance in crime in a digital-age population, which will aid policy makers in creating policies to shape a safer society as civilizations continue to further applications of communication technology. The covariates of the crime studied are the Internet usage, biological sex, sleep duration, fast food intake, medical history, alternative medicine use, and illegal drug use.

LITERATURE REVIEW

The Internet Use & Crime

In the era of the digital world, both hardware and software are available at an affordable price. According to Statista.com, 64.6% of the world population are the Internet users with 59.9% being social media users in 2023 (Ani, 2023). Many studies revealed that the cybercrime related study such as awareness of cybercrime, predictor of cybercrime, etc., but there is a lack in the research to discover the relationship between the Internet usage and frequency of crime committed, especially non-cybercrime. Therefore, this study is conducted to fill the research gap.

Academic Performance & Crime

There are many studies to prove that certain factors affect crime, one of them being academics. The unemployment rate due to an inadequate level of education affects crime rates because these insufficiently educated people, especially young people, end up resorting to crime for living (Ahmed et al., 2019). The higher the education, the lower the chance of occurrence of crimes. Grade retention also affects the crime rate, as studies found that students retaining in their eighth grade give way to a higher crime activity when they are grown adults (Eren et al., 2022). Students retained in certain grades due to their promotion policy could create significant negative effects in the form of more violent crimes committed in the future. Furthermore, a significant negative correlation was discovered in the relationship between successful enrolment in any secondary level institution as opposed to none and crime rates in Finland (Huttunen et al., 2023). Furthermore, if one had undertaken a good quality intensive early childhood education program, the likelihood of committing a crime is reduced (Garcia et al., 2019). Another study in Mexico found that homicide rates had decreased by 55.0% from 1992 to 2007 with increased attendance in secondary and tertiary schools after a compulsory schooling law in the country (Gleditsch et al., 2022). Furthermore, education increases and widens the employment opportunities of a person. With improvement of one's career opportunities, a higher salary is expected, giving the person a better future expectation. Individuals will look more forward to their future instead of possible punishment from the commitment of crime, hence discouraging their participation in crime (Lochner, 2020).

Biological Sex & Crime

Wesely (2021) asserts that gender is the "strongest predictor of the involvement of the criminal justice system", and this can be evidenced by the overwhelming arrested men in the USA in all 30 categories in 2019 except prostitution and embezzlement, which stood at 37.0% and 49.8% of men, respectively, resulting in a total male offender rate of 72.5% (Federal Bureau of Investigation, 2020). Even then, the percentage distribution of prostitution and embezzlement offenders arrested among all categories was a total of 0.4%. Despite this staggering gender gap, research has shown that the number of women committing crimes has been slowly increasing over the last 50 years, ignoring a sharp drop after World War II (Campaniello, 2019). A research found a weak correlation between gender and criminal thinking, as though both male and female respondents scored low in criminal thinking, females on average have slightly higher scores in certain styles of criminal thinking categorized in the psychological inventory of criminal thinking styles (Benson & Harbinson, 2020). This may be relevant to how female offenders have the slightest majority in embezzlement crime statistics, which is a type of white-collar crime (Federal Bureau of Investigation, 2020).

Additionally, demographics are always the main concern when discussing issues of academic performance. Regarding the demographics, it included a wide range of scope such as age, gender, socioeconomic, racial, culture, and mother language. Through a study in Malaysia (Syaza et al., 2020), it was

shown that poor academic performance is correlated with gender and households with poor income. The ratio of male respondent to female respondent in the scenario of passing the English language writing subject was a ratio of one to three. The probability of passing mathematics for students from lower-income households was almost 7.8 times lower than students from higher-income households with a minimum threshold of RM8319.

Sleep Duration & Crime

Sleep is one of the most important activities of a human being. In fact, a whole third of human lives are spent either sleeping or at least attempting to do so. Without sleep, cognitive functions are affected and causes a whole myriad of problems. However, in relation to crime, poor sleep quality, such as those who suffer from sleep deprivation or disturbances, has been associated with higher levels of hostility and aggression among adults. Javakhishvili and Widom (2022) reported that sleep problems are neither a significant predictor nor a mediator of adult arrests. However, in another study among inmates in eastern Ethiopia, poor sleep quality was found to have a statistically significant association with the type of crime committed, namely rape and assault (Getachew et al., 2020). These studies strongly suggest that a lack of sleep or a continued disturbance of it increases the likelihood of committing a crime, whether it is current or future. It has been suggested that too much sleep can also cause the same problem and that there is a 'Goldilocks rule', that both too little and too much sleep are positively associated with delinquency (Mears et al., 2022).

Students with inadequate and inconsistent sleep tend to have weaker physical and mental health that will directly affect their academic performance (Sun et al., 2019). They may not be able to stay awake during the day, causing lack of focus during classes, and with their overworked selves, they may find it difficult to absorb and process new information. Furthermore, insomnia and deviation from optimal sleep duration, in particular sleep durations too short and too long similar to the aforementioned 'Goldilocks rule', predict a higher likelihood of failing examinations (Vedaa et al., 2019). The same study determined that insomniacs and longer sleepers were associated with delayed progression in studies.

Fast Food Intake & Crime

No recent studies investigating the relationship between fast food intake and criminal probability were found. However, Reuter et al. (2021) determined that high fast food consumption significantly affects the grade point average (GPA) of university students negatively. According to self-reported data, students with a minimum consumption of seven times a week scored considerably less GPA than their peers who completely resisted from such foods or consumed between one and three times a week.

Medical History & Crime

From a study in Chicago, Tung et al. (2019) have shown an association of increases in violent crime rate with elevated blood pressure in the local population during a three-year surge in crime. Additionally, recidivism has been documented to correlate negatively with the physical and mental health of a criminal (Link et al., 2019). On the other hand, the findings presented in the journal Health and Justice showed that chronic physical health symptoms such as high blood pressure were actually correlated with decreased inmate misconduct by 9.0% in non-serious categories and 13.0% in serious categories, while acute physical health symptoms, mental health symptoms and a combination of any two or all were each correlated with an increase in non-serious and some in serious inmate misconduct (Semenza & Grosholz, 2019).

Poor mental and physical health affects academic performance, as higher education suffer from it due to stress, leaving them with thoughts of leaving university, which can directly affect the progression of their academics (Egan et al., 2022). Additionally, people who suffer from certain disabilities such as attention-deficit/hyperactivity disorder (ADHD) may have their academic results affected. As this disorder could carry over even when a person grows older, it is assumed that a person diagnosed with ADHD even at a young age has difficulties in performing certain tasks such as reading and paying attention during classes when they are adolescent, resulting in lower test scores compared to other healthy peers (Arnold et al., 2020).

Alternative Medicine Use & Crime

Recent studies were not found that investigated the relationship between alternative medicine use and crimes that involve direct harm to life or theft. However, Raposo (2019) lists several types of medical malpractice, which is a criminal offence, associated with the prescription of alternative medicine. Practitioners can be found operating with licenses by regulating bodies and association of respective practices, in addition to intentional omissions or rejection of conventional medicine without proper basis on possible improvement of health in order to retain patients or negligence to acknowledge effects of conventional medicine. This issue is mostly intrinsic to the nature of alternative medicine that believes in medicinal philosophies over scientific research, but it does not dismiss the fact that it is medical malpractice because it fails to uphold a standard of care equal to conventional medicine.

On the other hand, anxiety has been a common factor in losing confidence, especially for people taking exams. Anxiety before the exam can cause a person to lose their self-confidence and focus during their exam, causing a decrease in test performance. Cavalca and dos Santos de Almeida (2022) found that acupuncture can help improve test-taker performance by reducing anxiety and other behavioral changes as part of its anxiolytic effect. This follows Baesso et al. (2019), which in fact discovered reduced anxiety levels after receiving acupuncture, which reduced their anxiety days before and during the exam. Similarly, herb remedies are frequently used to reduce anxiety, according to Motti and de Falco (2021), and a similar effect to acupuncture is possible on test-taking performance. Despite that, no concrete evidence has been presented in both cases.

Illegal Drug Use & Crime

A study by Kaye et al. (2021) found that people addicted to methamphetamine are more likely to engage in violent behavior and violent crime. In fact, a study has shown that there was a very significant 1,320.0% increase in the likelihood of committing a crime during months in which methamphetamine was used, compared to months in which it was not (McKetin et al., 2020). Methamphetamine use is also associated with violent self-harm, particularly to the point of inducing death or suicide, according to Al-Asmari (2021). In fact, 18.0% of all methamphetamine-related deaths involve suicide, with 85.0% of those suicides involving violent means such as hanging, exsanguination, or firearms. On the other hand, according to Wu et al. (2021) in a study conducted on Oregon's legalization of marijuana, there is a significant increase in most types of criminal activity, namely violent and property crimes, compared to 19 other states in America that have not yet legalized marijuana. However, other findings indicate that the impact of serious crimes in Colorado and Washington State after legalization has been minimal, and apart from a notable decrease in burglary rates in Washington, there are no apparent long-term repercussions on violent or property crime rates (Lu et al., 2021). Similarly, Brinkman and Mok-Lamme (2019) suggest through their findings that legalizing marijuana will drive out organized crime and reduce crime by 19.0% in a neighborhood of about 10,000 residents by altering security practices. Through strict control of prescription drug monitoring programs, 5.0% of the reduction in overall direct crime activity was supported by various pieces of evidence (Dave et al., 2021).

One of the main reasons students turn to illegal drug use may be due to the stress or anxiety of academic study. Statista statistics show that cannabis (marijuana) was the most used drug (18.1%) by Canadian students from grade 7 to 12 who practiced illegal drugs for two years since 2018 (Elflein, 2020). Similar scenarios can be seen in medical students who practice the use of alcoholic beverages, sedatives, marijuana, *Nicotiana tabacum* (cultivated tobacco), and sleeping pills. In a case sample study, the ratio of alcoholic beverages to tobacco to marijuana used by medical students was 18:9:7 (Ferreira et al., 2022). Only fourth-year classes of medical students were found to have higher use of marijuana while medical students undergoing internship were found to be using less tobacco. The study also found that the use of illegal drugs in medical students has been significantly correlated with poorer academic performance.

Conceptual Framework

The literature review of the covariates of crimes is summarized in [Table 1](#) and the covariates of academic performance in [Table 2](#).

Table 1. Covariates of crime in previous studies

Covariate	Detail variables	Type of crime	Previous studies
Academic performance	Education	Crime rate	Ahmed et al. (2019) & Lochner (2020)
	Eighth grade retention	Adult crime conviction	Eren et al. (2022)
	Secondary school admission & type of secondary school	Committed crime by years 1, 5, & 10	Huttunen et al. (2023)
	Intensive early childhood education program	Number of crimes committed by type & gender	García et al. (2019)
Biological sex	Biological sex	Crime rates	Campaniello (2019) & Federal Bureau of Investigation (2020)
		Criminal thinking	Benson and Harbinson (2020)
Sleep duration	Sleep problems	Adult arrests	Javakhishvili and Widom (2022)
	Time of sleep & time of wake	Rape & assault	Getachew et al. (2020)
		Delinquency	Mears et al. (2022)
Fast food intake	No recent studies were found		
Medical history	High blood pressure	Crime surge	Tung et al. (2019)
	Acute & chronic physical health, mental health, & co-occurring health conditions	Non-serious & serious inmate misconduct	Semenza and Grosholz (2019)
	Physical health limitations & depression	Reincarceration	Link et al. (2019)
Alternative medicine use	Complementary & alternative medicine prescription	Medical malpractice	Raposo (2019)
Illegal drug use	Drug use	Crime activity	Dave et al. (2021)
		Crime rates	DOSM (2021)
	Marijuana use		Brinkman and Mok-Lamme (2019), Lu et al. (2021), & Wu et al. (2021)
	Crystal meth use		Al-Asmari (2021), Kaye et al. (2021), & McKetin et al. (2020)

Table 2. Covariates of academic performance in previous studies

Covariate	Detail variables	Type of crime	Previous studies
Digital technologies	Social media, smartphone, online shopping, & online game	CGPA	Ting et al. (2023)
Biological sex	Gender, ethnicity, & household income	Malay, English (comprehension & writing), math, & science scores	Syaza et al. (2020)
Sleep duration	Insomnia & sleep duration	Failed study examinations/delayed study progression	Vedaa et al. (2019)
	Weekday-to-weekend difference in sleep timing & sleep duration	Academic performance	Sun et al. (2019)
Fast food intake	Fast food consumption	Negative academic achievement effect	Reuter et al. (2021)
Medical history	ADHD disability	Lower test scores	Arnold et al. (2020)
	Poor mental & physical health	Academic progression	Egan et al. (2022)
Alternative medicine use	Acupuncture	Pre-exam anxiety	Baesso et al. (2019) & Cavalca and dos Santos de Almeida (2022)
	Herb remedies	Pre-exam anxiety	Motti and de Falco (2021)
Illegal drug use	Marijuana, tobacco, sedative, alcoholic beverage, & sleeping pills use	Academic performance	Ferreira et al. (2022)

Based on the literature review, a conceptual framework was conceived to mediate the action of academic performance in crime, with predictors of the Internet usage, biological sex, duration of sleep, fast food intake, medical history, use of alternative medicine use of illegal drug use.

Hypotheses for this study are constructed based on the conceptual framework, as shown in [Figure 1](#), as follows:

H1. The Internet usage correlates with crime.

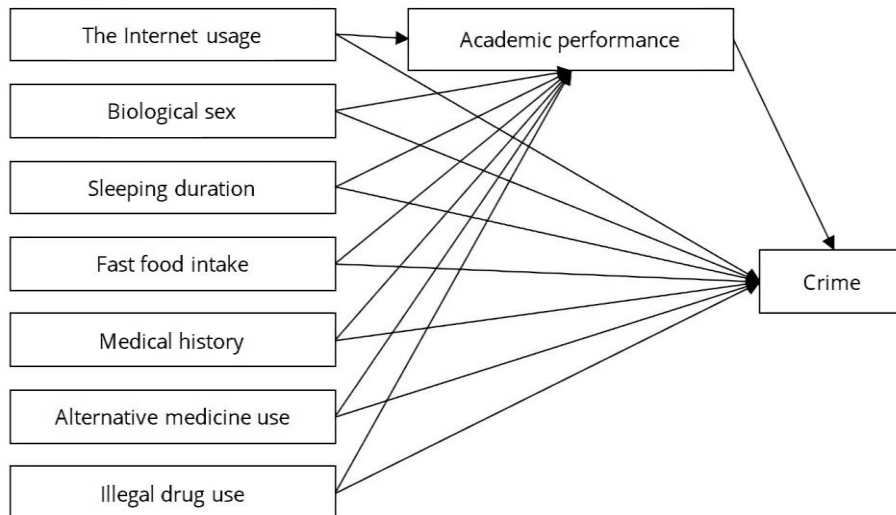


Figure 1. Conceptual framework of crime covariates & mediator (This conceptual framework is constructed by this study based on the literature review)

- H2.** Academic performance mediates the relationship between the Internet usage and crime.
- H3.** Biological sex correlates negatively with crime.
- H4.** Academic performance mediates the relationship between biological sex and crime.
- H5.** Sleep duration correlates negatively with crime.
- H6.** Academic performance mediates the relationship between sleep duration and crime.
- H7.** Fast food intake correlates positively with crime.
- H8.** Academic performance mediates the relationship between fast food intake and crime.
- H9.** Medical history correlates positively with crime.
- H10.** Academic performance mediates the relationship between medical history and crime.
- H11.** Alternative medicine use correlates positively with crime.
- H12.** Academic performance mediates the relationship between alternative medicine use and crime.
- H13.** Illegal drug use correlates positively with crime.
- H14.** Academic performance mediates the relationship between illegal drug use and crime.

RESEARCH METHODOLOGY

The data sets used in this study were obtained from the data archive of the Inter-University Consortium for Political and Social Research (ICPSR). ICPSR is an international consortium of academic institutions that notably provides data access in the fields of social and behavioral sciences research of more than 250,000 files (Harris & Udry, 2022). ICPSR provides data sets collected from the national longitudinal study of adolescent to adult health (add health) as ICPSR 21600, which is a longitudinal study that has collected a large amount of demographic, social, familial, socioeconomic, behavioral, psychosocial, cognitive, and health data from adolescents and adults in the USA through its five waves of study from 1994 to 2018 (Harris & Udry, 2022). Wave III was conducted between August 2001 and April 2002 on 15,170 wave I respondents who have transitioned into adulthood between 18 and 26 years old since the 1994-1995 study and had gathered data on relationships, pregnancies, live births, children and parenting, education, graduation, on top of demographic and health information (Harris & Udry, 2022). This paper uses two wave III data sets among the 42 publicly available data sets currently available: D58–demographic and health information and D16 – education. These data sets are merged and cleaned using IBM SPSS statistics 26.0. Since this is a longitudinal study for a large population, there are some possible internal threats such as loss of subjects during the study. Therefore, the range of responses from one wave to another is reducing. To overcome this, data cleaning and transformation is performed, and the details are explained in the following section.

Table 3. Questionnaire items details of variables

Data set	Variable name	Description
DS8	FRQCRIME	In the past 12 months, cumulative frequency of the following types of crime: <ul style="list-style-type: none"> • Deliberate damage to property not owned • Steal something worth more than \$50 • House or building entry to steal something • Use or threaten to use a weapon to get something <ul style="list-style-type: none"> • Sell drugs • Steal something worth less than \$50 • Participation in a physical group fight <ul style="list-style-type: none"> • Buy, sell, or hold stolen property • Unauthorized credit or bank card use <ul style="list-style-type: none"> • Deliberately write a bad cheque <ul style="list-style-type: none"> • Weapon use in fight • Carry a handgun to school or work <ul style="list-style-type: none"> • Belong to named gang* <p><u>Values for each crime (unless otherwise specified):</u> (0) never; (1) 1 or 2 times; (2) 3 or 4 times; & (3) 5 or more times & *values: (0) no & (1) yes</p>
	BIOSEX	Respondent's biological sex <u>Values:</u> (1) male & (2) female
	SDURWORK	Sleep duration in minutes on the night before work/school days (or similar days with obligations to wake up at a certain time)
	SDURREST	Sleep duration in minutes on the night before rest days (days without obligations to wake up at a certain time)
	FASTFOOD	On how many of the past seven days did you eat food from a fast-food place, McDonalds, Kentucky Fried Chicken, Pizza Hut, Taco Bell, or a local fast-food restaurant? <u>Values:</u> (0) no days; (1) 1 day; (2) 2 days; (3) 3 days; (4) 4 days; (5) 5 days; (6) 6 days; & (7) 7 days
	MEDHIST	Number of diagnoses of the following medical conditions (1 per option): <ul style="list-style-type: none"> • Asthma • Cancer/leukemia • Depression • Diabetes • Epilepsy/seizure • High cholesterol • High blood pressure
	ALTMED	Number of uses of the following alternative medicine in the past year (1 per option): <ul style="list-style-type: none"> • Acupuncture • Biofeedback • Chiropractic treatment • Energy healing • Folk remedy • Herb remedy • Homeopathy • Hypnosis • Health imagery • Health massage
	DRUGS	Number of uses of the following illegal drugs since June 1995 (1 per option): <ul style="list-style-type: none"> • Marijuana • Cocaine • Crystal meth • Other drugs (eg. LSD, PCP, ecstasy, mushrooms, inhalants, ice, heroin, or prescription medicines not prescribed) • Drugs by injection
DS16	ACADPERF	Overall GPA for all courses taken in high school cumulatively.
DS22	INTERNET_HR	Hours spend on the Internet in the past seven days.

120 variables and 1,879 cases are obtained in total after the data set cleansing and transformation process. The variables are then further filtered to conform to the conceptual framework used. This includes seven independent variables (IVs), one mediator variable, and one dependent variable (DV) (Table 3). For DV of crime, 12 ordinal variables of frequency of involvement in crime, one dichotomous variable of named gang involvement, were merged into one variable. For the mediator variable of academic performance, the cumulative GPA was used for all high school years. For IVs, the Internet usage, biological sex and fast food

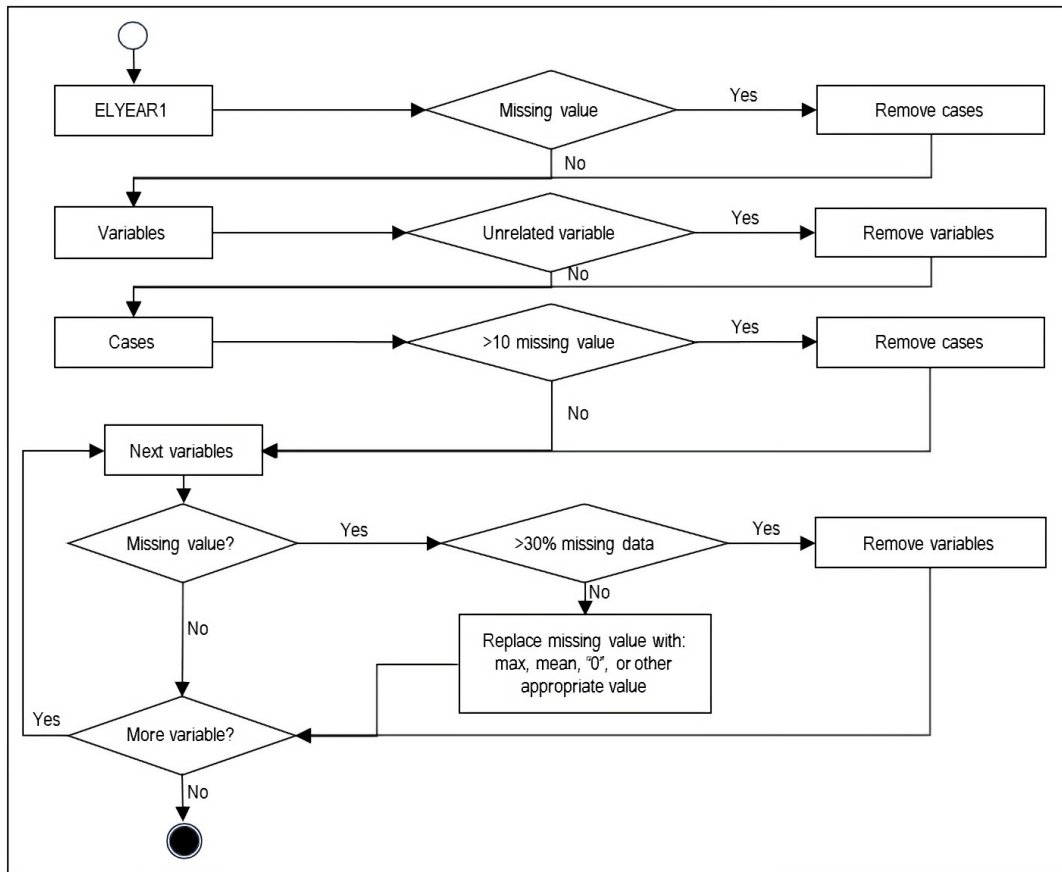


Figure 2. Data set cleaning & transformation workflow (Ting et al., 2022)

intake frequency were used as is. The duration of sleep on work/school days and rest days was calculated separately based on self-reported sleep and wake times. Medical history, alternative medicine use, and illegal drug use were the merger of several dichotomous variables on the presence of diagnosis or use of each option. The values and options for each variable are shown in **Table 3**. The definition of medical history and use of alternative medicines are presented in **Table 3**.

The merged data sets are cleaned and transformed according to the steps illustrated in **Figure 2**. This methodology is adapted from the research by Ting et al. (2022), which utilized big data set ICPSR in discovering the covariates of romantic relationship among young adults in the USA (Ting et al., 2022). When viewing the variable of high school course-taking (ELYEAR1), if a case has a missing value for this variable, the case is removed. Then, unrelated variables and cases with more than 10 missing values are removed from the data set. For each variable, if it has more than 30.0% missing data, it is removed; otherwise, missing values are replaced with the maximum, mean, 'zero' or other appropriate values. The last step is to combine an additional variable from DS22–hours spent on the Internet to explore the connection between digital culture and crime. A total of 1660 cases are finalized after data cleansing.

Data analyses are performed using IBM SPSS statistics 26.0 for Pearson’s correlation analysis and macro PROCESS 4.2 for mediation analysis. First, descriptive statistics are calculated for the quantitative variables. The Pearson correlation between chosen IVs and DVs is then analyzed by using the bivariate function in the SPSS statistics software. Next, for mediation analyses, the macro PROCESS by Andrew F. Hayes is used with 5,000 bootstrap samples, model number 4, standardized effects, and 95% confidence interval to examine direct effects (DEs) and indirect effects (IEs) in the mediation models. The level of significance or p is denoted with asterisks for each pair of mediation analysis: IV–mediator–DV.

Table 4. Pearson correlation analyses between covariates & crime

Variable	M	SD	1	2	3	4	5	6	7	8	9
1. FRQCRIME	0	-									
2. ACADPERF	2.760	0.689	-.125***								
3. BIOSEX	-	-	-.206***	.228***							
4. SDURWORK	450	157.380	-.0150	-.025	.043						
5. SDURREST	560	184.250	-.0220	-.011	.016	.191***					
6. FASTFOOD	2	-	.0570*	-.149***	-.089***	-.052*	.009				
7. MEDHIST	0	-	.0440	-.021	.104***	-.012	-.025	-.010			
8. ALTMED	0	-	.070**	.042	.067**	.006	-.012	-.089***	.062**		
9. DRUGS	0	-	.326***	-.080***	-.131***	-.004	-.044	-.028	.070**	.129***	
10. THE INTERNET	6.190	9.456	0.075**	-.025	-.076**	.002	.008	.004	.021	.010	-.003

Note. M: Median; SD: Standard deviation; *Sig. (2-tailed)<0.05; **Sig. (2-tailed)<0.01; & ***Sig. (2-tailed)<0.001

Table 5. Direct & indirect effects for mediation analyses

Predictor	Mediator	DV	DE	IE (BootLLCI, BootULCI)
THE INTERNET	ACADPERF	FRQCRIME	.0141*	.00320 (-.0031, .0098)
BIOSEX	ACADPERF	FRQCRIME	-.6905*	-.06900 (-.1091, -.0333)
SDURWORK	ACADPERF	FRQCRIME	-.0001	.00000 (.0000, .0001)
SDURREST	ACADPERF	FRQCRIME	-.0001	.00000 (-.0001, .0001)
FASTFOOD	ACADPERF	FRQCRIME	.0348*	.01550 (.0088, .0239)
MEDHIST	ACADPERF	FRQCRIME	.0517	.00230 (-.0170, .0210)
ALTMED	ACADPERF	FRQCRIME	.1643*	-.01460 (-.0319, .0002)
DRUGS	ACADPERF	FRQCRIME	.5315*	0.0133 (0.0053, 0.0230)

Note. *p<0.05; DV: Dependent variable; & IE: Indirect effect

RESULTS

Preliminary Analysis

The descriptive statistics and Pearson's correlation between IVs and crime are reported in **Table 4**. The first discovery is the significant relationship between the Internet usage (other than work or school) and the frequency of crime committed ($r=6.190$, Sig.<0.010). Therefore, digital culture affects the crime committed among the young generations. Since the correlation is positive, this also reveals that the higher involvement in the Internet for non-working or school activities increases crime committed. **H1** is accepted on this result. The results also show significant negative correlations at the 0.001 level between academic performance and crime ($r=-0.125$, Sig. (2-tailed)<0.001), as well as between biological sex and crime ($r=-0.206$, Sig. (2-tailed)<0.001). Furthermore, an increase in fast food intake was significantly correlated at the 0.05 level with increased criminal frequency ($r=0.057$, Sig. (2-tailed)<0.050). Therefore, **H3** and **H7** are accepted. On the other hand, a significant positive correlation was found at the 0.001 level between illegal drug use and crime ($r=0.326$, Sig. (2-tailed)<0.001), and at the 0.010 level between alternative medicine use and crime ($r=0.070$, Sig. (2-tailed)<0.010). Therefore, **H11** and **H13** are also accepted. The strengths of the correlations were mostly weak, with only the correlation coefficients between biological sex and crime, as well as between illegal drug use and crime, indicating a moderately weak correlation. However, each of the work/school day sleep duration, the rest day sleep duration and medical history did not correlate significantly with crime. Thus, **H5** and **H9** are rejected.

Mediation Analysis

DEs and IEe with a bootstrap 95% confidence interval for mediation analysis of academic performance in the relationship between predictors and crime are reported in **Table 5**. Through mediation analysis, academic performance was found to be a significant mediator when predictors are Internet usage other than work/school (IE=.0032), biological sex (IE=-0.0690), fast food consumption (IE=.0155), overall health condition (IE=.0023), alternative medicine use (IE=-.0146) and illegal drug use (IE=0.0133, 95% CI=[0.0053, 0.02300]). Therefore, **H2**, **H4**, **H8**, **H10**, and **H14** are accepted. In contrast, academic performance did not significantly mediate the relationship between sleep duration and crime (IE=.0000). Thus, **H6** is rejected.

DISCUSSION

The Internet Usage

Fu et al. (2022) found a significant connection between the Internet addiction and emotional distress. This finding supported the present study, which shows that there is a significant relationship between the Internet usage and crime, and academic performance also acts as mediator in between the predictor and crime. Fu et al. (2022) focus on adolescents aged 13 to 19 years, while this present study focus on 18-26 years of young adult. Therefore, it is obvious that the Internet usage or addiction should be controlled among children and young adults to avoid crime. This could be due to exposure to the variety of contents on the Internet without filtration. Therefore, it is crucial to design an effective technique or software that could perform deep content filtering before reaching young generation to protect their well-being.

Biological Sex

Based on the result obtained, biological sex and crime are significantly related. This aligns with the observation of the FBI report (2020), which displays an obvious male offender majority across most categories and in general. The same applies to the research findings of partially higher criminal thinking scores in female respondents compared to male respondents (Benson & Harbinson, 2020). A similar study conducted on a more diverse sample of criminals may help reveal the correlation between gender and criminal thinking or criminal act.

Academic performance significantly mediates biological sex and crime in the present study, which conforms to previous research by Syaza et al. (2020) revealing that women have better academic performance compared to men. Previous research by Pascual et al. (2019) agreed that gender is also a significant mediator that influences the relationship between executive function and academic performance at the primary education. Although this may be caused by earlier maturational development in women leading to improved cognitive ability, this initial advantage allows female students to perform better later in higher education even after male maturity.

Sleep Duration

Although this present study showed that there is no significant correlation between sleep duration and crime, this result is consistent with Javakhishvili and Widom (2022), which similarly found no links between sleep problems and adult arrests. However, Getachew et al. (2020) reported correlations between poor sleep quality and certain types of crime. This contradiction can be explained by the influence of other covariates, such as the environment of the jail and the possible discriminatory treatment by correctional officers based on the type of offence.

Academic performance also does not mediate the relationship between sleep duration and crime in the mediation analysis in the present study. Sun et al. (2019) and Vedaa et al. (2019) revealed different results compared to this present study in which insufficient and inconsistent sleep was associated with academic failures. Furthermore, Mears et al. (2022) and Vedaa et al. (2019) both suggested correlations between optimal sleep duration deviation and delinquency for the former study and examination failure in the latter, which contradicts the rejection of the hypothesis. It may be possible that reduced attention due to lack of sleep and additional study efforts when awake longer result in negligible differences in academic performance. More research is required to conclusively describe the relationship between sleep and academic performance, which will help to understand the mediating role of academic performance between various factors and crime.

Fast Food Intake

In this present study, fast food intake is significantly related to crime. There is no recent literature that has investigated this IE, but it may be possibly related to increased fast food consumption due to severe food insecurity among adolescents (Smith et al., 2022). Thus, it may be speculated that food insecurity have an overlap of consuming cheaper food, such as fast food and committing crimes to acquire living necessities or expenses.

The mediation of academic performance between fast food intake and crime is not significant based on observation of the results. Compared to the study by Reuter et al. (2021), which found that higher intake of fast food in students indeed correlating to poorer academic performance compared to their peers who consume less of the same type of food. It can be inferred that although high fast food consumption and poor academic performance separately indicate crime, academic performance does not mediate the effects of fast food intake on crime.

Medical History

The correlation between medical history and crime was not significant in the present study. It is recalled that the medical history in our data represents the number of diagnoses of medical conditions including asthma, cancer / leukemia, depression, diabetes, epilepsy/seizures, high blood cholesterol and high blood pressure. Of the seven medical conditions considered, six are chronic physical health conditions and depression is the sole mental health condition. Therefore, this result disagrees with several studies (Link et al., 2019; Semenza & Grosholz, 2019; Tung et al., 2019) that suggest some form of correlation with health and delinquency or crime. Compared to Tung et al. (2019), it is possible that any effect of health conditions on crime can only be seen when investigating individual health conditions. Moreover, the data used only consider any or no diagnosis for a particular health condition at any period of time for a person, and that health condition could already have been cured at the time of data collection; hence, no observed effect of medical conditions on crime.

The mediation analysis of the present study shows that academic performance mediates the relationship between medical history and crime. This result is confirmed with the findings of Egan et al. (2022) of poor health discouraging academic efforts to the point of withdrawing from education among students. Arnold et al. (2020) demonstrated how disabilities may hinder learning and thus academic performance should have been negatively affected. Similarly, this hypothesis may be re-examined given more precise medical condition data, including timing and progress of treatment.

Alternative Medicine Use

The correlation of the use of alternative medicine with crime is significant based on the present study. This is consistent with Raposo (2019) on the issue of malpractice among alternative medicine providers. It may be speculated that users of alternative medicine may proceed to endorse and sell possibly fraudulent substances believed to be drugs, predisposing themselves to other types of criminal offence. Furthermore, as shown in the results, the significant positive correlation between illegal drug use and crime may explain this effect, as well as the overlap of alternative drug users and illegal drug users. Marijuana, which has been considered an illegal drug in this study, is sometimes used as an alternative medicine and is commonly referred to as 'medical marijuana'. The number of the US states decriminalizing medical marijuana has been increasing in the past few years and it stands at 38 out of 50 US states as of 2023 (NCSL, 2023). Some users of marijuana for medical purposes may purchase their substance from unlicensed or illegal vendors and expose themselves to other illegal drugs and other illegal activities in the process. Further research is suggested on the mediation of illegal drugs in the relationship between alternate medicine use and crime.

According to the present study, academic performance mediates the relationship between the use of alternative medicine and crime. Compared to previous research by Cavalca and dos Santos de Almeida (2022), alternative medicine helps reduce the anxiety level of a person, which will then improve their performance in the test. However, the results of the present study show the opposite to their findings, and this is likely due to the short-term effects of alternative medicine. As the data used in this study lack precision, where alternative medicine use is considered only if it was used within the past year, without considering the dosage, frequency, and timing of the intake, no correlation can be established between the two variables. For example, the respondent only took alternative medicine for a short period of time long before or after a school assessment, so the effects suggested in Cavalca and dos Santos de Almeida (2022) were not found. It may be impossible to quantitatively determine DE of alternative medicine use on academic performance without detailed usage patterns.

Illegal Drug Use

The present study shows that there is a significant positive correlation between illegal drug use and crime. This agrees with many studies (Al-Asmari, 2021; Kaye et al., 2021; McKetin et al., 2020) that directly investigating illegal drug use and crime. This is expected considering the inhibition of cognitive function by illegal drugs in addition to the potential exposure to and subsequent participation in other criminal activities when purchasing or using illegal drugs. The results also agree with Wu et al. (2021) when presumably use of marijuana increased as it was legalized, which was associated with increased criminal activity, as well as Dave et al. (2021) when crime is reduced due to stricter control is applied on prescription drugs.

The result of the mediation analysis of academic performance between illegal drug use and crime is significant. When illegal drugs are consumed, academic performance is negatively affected and, thus, crime is higher. This result agrees with Ferreira et al. (2022) findings of illegal drug use predicting poorer academic performance. It is observed that when individuals consume illegal substances that can turn into substance abuse to cope with pressure, inhibited cognitive functions discourage academic efforts and negatively impact academic performance. As poor academic performance can lead to difficulty in job searching, these same individuals may turn to criminal activities they were exposed to via previous illegal substance purchases to earn money.

CONCLUSIONS

In exploring the mediating role of academic performance in digital age crime, the present study has found links between biological sex, higher non-working/non-school work the Internet usage, fast food intake, alternative medicine use, and illegal drug use each individually with frequency of criminal activity. Furthermore, the mediation of academic performance to crime frequency was highlighted when the predictor was the Internet usage, biological sex, fast food intake, medical history, alternative medicine use, illegal drug use. The findings partially support the overall role of academic performance as a mediator of crime; thus, this necessitates the elevation of academic success in each nation in order to combat crime, which can be done by providing equal access to both genders and reducing illegal drug use.

However, this study has several limitations that should be addressed in future research. For example, the sample was limited to young adults in the USA, so it is unclear whether these findings generalize to other populations with different ages or countries that may have vastly different cultural views on academic performance or different criminal scenes. The use of communications technology also varies between nations, such as the famous focus on fax machines instead of digital documents in Japan still practiced decades later. The results of the present study may resemble but also differ from a similar study done using more current data due to the prevalence of short form networks on social media now as compared to longer forms of media or communication transmitted through televisions, email and landline phones. Furthermore, the study relied on self-reported data for all data except academic performance, which may be subject to bias. Data for medical history, alternative medicine use and illegal drug use also lacked precision, as details such as frequency, dosage, and medical condition that can greatly differ between cases were not considered. Further research should employ more objective and precise measures of sleep pattern, food intake, medical history, use of alternative medications, and illegal drug use, in addition to including more diverse samples to explore these trends on a global scale. In addition, the method used in this study is also limited to Pearson correlation and mediation analysis, which might not be able to reveal the nuance relationship between the variables. Future studies could include different methodologies and machine learning algorithms to further discovering the relationship between variables. The structural equation model and linear regression analysis can also be used to explore the confounding factors in crime acts.

ICPSR data set questionnaire items used were also found to be different from other research in terms of the options and the design of the questionnaire. It is interesting to further explore different design of questionnaire for the same variable (e.g., crime) that might produce a different result. Another potential study is to break down different crime and analyze its covariates accordingly.

Controlling crime on a national scale demands responsible policies by governments to raise the academic performance of its citizens, which may also develop civic consciousness that deter people from committing

crimes. Policy makers must first be eliminated by policy makers, and subsequently, academic success should see equal representation between genders. Additional studies can be conducted to explore the reasons biological sex determines academic performance, and the results may be used to improve the less efficient population and reduce the gap between the two genders. Therefore, both genders may be fairly represented in the social and technological development of the country. Furthermore, exposure to illegal drugs can also lead to a person's exposure to criminal activity, and consumption of these drugs causes effects that hinder academic activities, leading to a higher likelihood in participating in crime. Therefore, authorities must end to illegal drugs at its source and severely crack down on their circulation. Government and media agencies can further discourage attempts to take illegal drugs through educational media and awareness campaigns in which the dangers and punishments of illegal drug activity are clearly communicated.

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REFERENCES

- Ahmed, B., Abdullah, U., & Akhtar, S. (2019). The relationship between education and crime analysis (1991-2016): A case study of Pakistan. *International Journal of Humanities, Arts and Social Sciences*, 5(5), 171-182. <https://doi.org/10.20469/ijhss.5.20001-5>
- Al-Asmari, A. I. (2021). Methamphetamine-related postmortem cases in Jeddah, Saudi Arabia. *Forensic Science International*, 321, 110746. <https://doi.org/10.1016/j.forsciint.2021.110746>
- Ani, P. (2023). *Statista-Worldwide digital population 2023*. <http://www.statista.com>
- Arnold, L. E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (2020). Long-term outcomes of ADHD: Academic achievement and performance. *Journal of Attention Disorders*, 24(1), 73-85. <https://doi.org/10.1177/1087054714566076>
- Ashby, M. P. J. (2020). Initial evidence on the relationship between the coronavirus pandemic and crime in the United States. *Crime Science*, 9, 6. <https://doi.org/10.1186/s40163-020-00117-6>
- Baesso C., A. M., Gomes, C., Nogueira, D. A., Rossi Junior, W. C., & dos Santos de Almeida, M. (2019). The effect of acupuncture on exam anxiety in medical students: A randomized crossover study. *Revista Internacional de Acupuntura [International Journal of Acupuncture]*, 13(2), 43-48. <https://doi.org/10.1016/J.ACU.2019.09.001>
- Benson, M. L., & Harbinson, E. (2020). Gender and criminal thinking among individuals convicted of white-collar crimes. *Criminal Justice Studies*, 33(1), 46-60. <https://doi.org/10.1080/1478601X.2020.1709953>
- Boman, J. H., & Gallupe, O. (2020). Has COVID-19 changed crime? Crime rates in the United States during the pandemic. *American Journal of Criminal Justice*, 45(4), 537-545. <https://doi.org/10.1007/s12103-020-09551-3>
- Brinkman, J., & Mok-Lamme, D. (2019). Not in my backyard? Not so fast. The effect of marijuana legalization on neighborhood crime. *Regional Science and Urban Economics*, 78, 103460. <https://doi.org/10.1016/j.regsciurbeco.2019.103460>
- Calamunci, F., & Drago, F. (2020). The economic impact of organized crime infiltration in the legal economy: Evidence from the judicial administration of organized crime firms. *Italian Economic Journal*, 6(2), 275-297. <https://doi.org/10.1007/s40797-020-00128-x>
- Campaniello, N. (2019). Women in crime. *IZA World of Labor*. <https://doi.org/10.15185/izawol.105.v2>

- Cavalca, A. M. B., & dos Santos de Almeida, M. (2022). A hypothesis about acupuncture's anxiolytic mechanism of action and its effect on the formation of self-efficacy beliefs and academic performance. *Revista Internacional de Acupuntura [International Journal of Acupuncture]*, 16(3), 100194. <https://doi.org/10.1016/J.ACU.2022.100194>
- Cordeiro, M., Kwenda, P., & Ntuli, M. (2020). Crime and life satisfaction: Evidence from South Africa–Gauteng province. *Applied Research in Quality of Life*, 15(3), 715-736. <https://doi.org/10.1007/s11482-018-9685-1>
- Dave, D., Deza, M., & Horn, B. (2021). Prescription drug monitoring programs, opioid abuse, and crime. *Southern Economic Journal*, 87(3), 808-848. <https://doi.org/10.1002/soej.12481>
- DOSM. (2021). Crime statistics Malaysia 2022. *Ministry of Economy, Department of Statistics Malaysia*. <https://www.dosm.gov.my/portal-main/release-content/crime-statistics-publication-202>
- Egan, H., O'Hara, M., Cook, A., & Mantzios, M. (2022). Mindfulness, self-compassion, resiliency and wellbeing in higher education: A recipe to increase academic performance. *Journal of Further and Higher Education*, 46(3), 301-311. <https://doi.org/10.1080/0309877X.2021.1912306>
- Elflein, J. (2020). Percentage of Canadian students in grades 7 to 12 who used select illicit drugs in the past year as of 2018-2019. *Government of Canada*. <https://www.statista.com/statistics/812363/past-year-illegal-drug-use-among-students-canada/>
- Eren, O., Lovenheim, M. F., & Mocan, H. N. (2022). The effect of grade retention on adult crime: Evidence from a test-based promotion policy. *Journal of Labor Economics*, 40(2), 361-395. <https://doi.org/10.1086/715836>
- Federal Bureau of Investigation. (2020). *Arrests, by Sex, 2019*. <https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/tables/table-42>
- Ferreira, P. M., Alves, R. J. R., & Zantut-Wittmann, D. E. (2022). Impact of the use of illicit and licit substances and anxiety disorders on the academic performance of medical students: A pilot study. *BMC Medical Education*, 22, 684. <https://doi.org/10.1186/s12909-022-03752-6>
- Fourie, J., Rosselló-Nadal, J., & Santana-Gallego, M. (2020). Fatal attraction: How security threats hurt tourism. *Journal of Travel Research*, 59(2), 209-219. <https://doi.org/10.1177/0047287519826208>
- Fu, S. C., Pang, N. T. P., & Wider, W. (2022). Relationship between Internet addiction, personality factors, and emotional distress among adolescents in Malaysia. *Children*, 9(12), 1883. <https://doi.org/10.3390/children9121883>
- García, J. L., Heckman, J. J., & Ziff, A. L. (2019). Early childhood education and crime. *Infant Mental Health Journal*, 40(1), 141-151. <https://doi.org/10.1002/imhj.21759>
- Getachew, Y., Azale, T., & Necho, M. (2020). Poor sleep quality and associated factors among prisoners of the Diredawa correctional facility in eastern Ethiopia. *Annals of General Psychiatry*, 19, 40. <https://doi.org/10.1186/s12991-020-00291-6>
- Gleditsch, K. S., Rivera, M., & Zárate-Tenorio, B. (2022). Can education reduce violent crime? Evidence from Mexico before and after the drug war onset. *Journal of Development Studies*, 58(2), 292-309. <https://doi.org/10.1080/00220388.2021.1971649>
- Gramlich, J. (2020). What the data says (and doesn't say) about crime in the United States. *Pew Research Center*. <https://www.pewresearch.org/fact-tank/2020/11/20/facts-about-crime-in-the-u-s/>
- Harris, K. M., & Udry, J. R. (2022). The add health (the national longitudinal study of adolescent to adult health). *Carolina Population Center*. <https://www.cpc.unc.edu/research-themes/projects/add-health-the-national-longitudinal-study-of-adolescent-to-adult-health/>
- Hunt, P. E., Saunders, J., & Kilmer, B. (2019). Estimates of law enforcement costs by crime type for benefit-cost analyses. *Journal of Benefit-Cost Analysis*, 10(1), 95-123. <https://doi.org/10.1017/bca.2018.19>
- Huttunen, K., Pekkarinen, T., Uusitalo, R., & Virtanen, H. (2023). Lost boys? Secondary education and crime. *Journal of Public Economics*, 218, 104804. <https://doi.org/10.1016/j.jpubeco.2022.104804>
- Javakhishvili, M., & Widom, C. S. (2022). Supplemental material for out-of-home placement, sleep problems, and later mental health and crime: A prospective investigation. *American Journal of Orthopsychiatry*, 92(3), 257-267. <https://doi.org/10.1037/ort0000609.supp>
- Jonathan, O. E., Olusola, A. J., Bernadin, T. C. A., & Inoussa, T. M. (2021). Impacts of crime on socio-economic development. *Mediterranean Journal of Social Sciences*, 12(5), 71. <https://doi.org/10.36941/mjss-2021-0045>

- Kaye, S., Lewandowski, A., Bowman, J., & Doyle, M. F. (2021). Crystal methamphetamine use among young people entering custody: Prevalence, correlates and comorbidity. *Drug and Alcohol Review, 40*(7), 1266-1274. <https://doi.org/10.1111/dar.13210>
- Khairunesa, I., Toong, H. S., Sarala, T. P., Nurliyana, M. R., Asokan, V., & Walton, W. (2022). The success of online learning approach of virtual mobility: A critical strategy. *The Seybold Report, 17*(106), 1085-1099. <https://doi.org/10.5281/zenodo.6703629>
- Koppel, S., Capellan, J. A., & Sharp, J. (2022). Disentangling the impact of COVID-19: An interrupted time series analysis of crime in New York City. *American Journal of Criminal Justice, 48*, 368-394. <https://doi.org/10.1007/s12103-021-09666-1>
- Link, N. W., Ward, J. T., & Stansfield, R. (2019). Consequences of mental and physical health for reentry and recidivism: Toward a health-based model of desistance. *Criminology, 57*(3), 544-573. <https://doi.org/10.1111/1745-9125.12213>
- Lochner, L. (2020). Education and crime. In S. Bradley, & C. Green (Eds.), *The economics of education: A comprehensive overview* (pp. 109-117). Elsevier. <https://doi.org/10.1016/B978-0-12-815391-8.00009-4>
- Lu, R., Willits, D., Stohr, M. K., Makin, D., Snyder, J., Lovrich, N., Meize, M., Stanton, D., Wu, G., & Hemmens, C. (2021). The Cannabis effect on crime: Time-series analysis of crime in Colorado and Washington State. *Justice Quarterly, 38*(4), 565-595. <https://doi.org/10.1080/07418825.2019.1666903>
- McKetin, R., Boden, J. M., Foulds, J. A., Najman, J. M., Ali, R., Degenhardt, L., Baker, A. L., Ross, J., Farrell, M., & Weatherburn, D. (2020). The contribution of methamphetamine use to crime: Evidence from Australian longitudinal data. *Drug and Alcohol Dependence, 216*, 108262. <https://doi.org/10.1016/j.drugalcdep.2020.108262>
- Mears, D. P., Tomlinson, T. A., & Turanovic, J. J. (2022). The Goldilocks rule—Too little, too much, and “just right”: Curvilinear effects of sleep duration on delinquency. *Justice Quarterly, 39*(2), 276-303. <https://doi.org/10.1080/07418825.2020.1729393>
- Motti, R., & de Falco, B. (2021). Traditional herbal remedies used for managing anxiety and insomnia in Italy: An ethnopharmacological overview. *Horticulturae, 7*(12), 523. <https://doi.org/10.3390/horticulturae7120523>
- NCSL (2023). *National Conference of State Legislatures—State Medical Cannabis Laws*. <https://www.ncsl.org/health/state-medical-cannabis-laws>
- Nurliyana, M. R., Toong, H. S., Khairunesa, I., Sarala, T. P., Siti, S. J., Asokan, V., & Xue, R. (2022). The readiness of using mobile-learning for Malaysian university students when facing the COVID-19 pandemic. *Social Science Journal, 12*(5), 379-387.
- Ozascilar, M., & Mawby, R. (2023). The impact of crime on tourists and the need for greater support for tourist victims. *International Review of Victimology, 29*(1), 3-15. <https://doi.org/10.1177/02697580221080006>
- Pascual, A. C., Moyano, N., & Robres, A. Q. (2019). The relationship between executive functions and academic performance in primary education: Review and meta-analysis. *Frontiers in Psychology, 10*. <https://doi.org/10.3389/fpsyg.2019.01582>
- Raposo, V. L. (2019). Complementary and alternative medicine, medical liability and the proper standard of care. *Complementary Therapies in Clinical Practice, 35*, 183-188. <https://doi.org/10.1016/j.ctcp.2019.02.009>
- Reuter, P. R., Forster, B. L., & Brister, S. R. (2021). The influence of eating habits on the academic performance of university students. *Journal of American College Health, 69*(8), 921-927. <https://doi.org/10.1080/07448481.2020.1715986>
- Semenza, D. C., & Grosholz, J. M. (2019). Mental and physical health in prison: How co-occurring conditions influence inmate misconduct. *Health and Justice, 7*, 1. <https://doi.org/10.1186/s40352-018-0082-5>
- Smith, L., Barnett, Y., Lopez-Sanchez, G. F., Shin, J. II, Jacob, L., Butler, L., Cao, C., Yang, L., Schuch, F., Tully, M., & Koyanagi, A. (2022). Food insecurity (hunger) and fast-food consumption among 180,164 adolescents aged 12-15 years from sixty-eight countries. *British Journal of Nutrition, 127*(3), 470-477. <https://doi.org/10.1017/S0007114521001173>
- Sun, W., Ling, J., Zhu, X., Lee, T. M. C., & Li, S. X. (2019). Associations of weekday-to-weekend sleep differences with academic performance and health-related outcomes in school-age children and youths. *Sleep Medicine Reviews, 46*, 27-53. <https://doi.org/10.1016/j.smrv.2019.04.003>

- Syaza, N., Ahmad, S., & Sulaiman, N. (2020). Demographic and socio-economic characteristics, household food security status and academic performance among primary school children in North Kinta, Perak, Malaysia. *Malaysian Journal of Medicine and Health Sciences*, 16(SUPP6), 2636-9346.
- Thompson, A., & Tapp, S. N. (2022). *Criminal victimization, 2021*. <https://bjs.ojp.gov/library/publications/criminal-victimization-2021>
- Ting, T. T., Lee, K. T., Lim, S. M., Lai, C. C., Omar, M. A., Alin, J., & Meri, A. (2023). Assessing the identity of digital technology in education in the age of digital communication. *Online Journal of Communication and Media Technologies*, 13(4), e202353. <https://doi.org/10.30935/ojcm/13695>
- Ting, T. T., Lee, S. C., Wee, M. C., & Chaw, J. K. (2022). Romantic relationship patterns, detailed covariates, and impacts on education: A study on young adults in the US using ICPSR data set. *Global Social Welfare*. <https://doi.org/10.1007/s40609-022-00254-7>
- Tung, E. L., Chua, R. F. M., Besser, S. A., Lindau, S. T., Kolak, M., Anyanwu, E. C., Liao, J. K., & Tabit, C. E. (2019). Association of rising violent crime with blood pressure and cardiovascular risk: Longitudinal evidence from Chicago, 2014-2016. *American Journal of Hypertension*, 32(12), 1192-1198. <https://doi.org/10.1093/ajh/hpz134>
- Vedaa, Ø., Erevik, E. K., Hysing, M., Hayley, A. C., & Sivertsen, B. (2019). Insomnia, sleep duration and academic performance: A national survey of Norwegian college and university students. *Sleep Medicine*, X, 1. <https://doi.org/10.1016/j.sleepx.2019.100005>
- Wesely, J. K. (2021). Research, gender, and crime. In J. C. Barnes, & D. R. Forde (Eds.), *The encyclopedia of research methods in criminology and criminal justice*. Wiley. <https://doi.org/10.1002/9781119111931.ch130>
- Wu, G., Wen, M., & Wilson, F. A. (2021). Impact of recreational marijuana legalization on crime: Evidence from Oregon. *Journal of Criminal Justice*, 72, 101742. <https://doi.org/10.1016/j.jcrimjus.2020.101742>
- Zhang, F., Fan, Z., Kang, Y., Hu, Y., & Ratti, C. (2021). "Perception bias": Deciphering a mismatch between urban crime and perception of safety. *Landscape and Urban Planning*, 207, 104003. <https://doi.org/10.1016/j.landurbplan.2020.104003>

