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Silent screams behind screens: An analysis of risk factors for cyberbullying victimization and protective strategies

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***Abstract*---**Using the official Taiwan Communication Survey Database and the propensity score matching method, this study classified 1852 adolescents as actual or potential cyberbullying victims. Findings showed males, poor performers, bystanders, and anxious individuals are at higher risk. Different types of bullying, especially cyber-behavioral bullying by acquaintances, have differing effects on self-esteem. Adolescents' responses range from seeking help to avoidance. More cyberbullying happens with educational rather than leisure internet use, suggesting educational pressure may trigger such incidents.

***Keywords*---**adolescent cyberbullying, cyberbullying victims, coping strategies, online exposure duration.

1. Introduction

With the growth of information and communication technologies (ICTs), bullying, especially in schools, has also increased. Taiwanese Ministry of Education data shows a rise in reported bullying cases, from 562 in 2018 to 1942 in 2022. While bullying differs among groups, the move from physical to online spaces is clear. Cyberbullying deeply harms victims, impairing mental health, academic performance, and social engagement, with severe consequences like suicide. Therefore, understanding and addressing cyberbullying has become an essential academic and societal priority.

Studies mainly focus on lower-grade students because of their crucial stage in social, emotional, and interpersonal growth. Bullying impacts their long-term well-being and academic achievement. With rising internet use, they may not fully

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understand cyberbullying (Leduc *et al.*, 2022), making them vulnerable. They often ignore online risks, seeing only the benefits. This emphasis in literature highlights their susceptibility, aiding educational institutions and families in creating appropriate education and support measures.

Lower-grade students primarily spend their time on classes and learning. Despite restricted ICT and internet use by teachers and parents, cyberbullying incidents still occur, linked to the unique characteristics of these adolescents and varying bullying types. Consequently, much research investigates the factors determining cyberbullying victims. Additionally, studies delve into the consequences of cyberbullying on adolescents, particularly its effects on self-esteem, a prevalent concern for this age group.

Using the Taiwan Communication Survey Database, this study investigates cyberbullying among Taiwanese students from elementary to high school. While examining determinants like gender, age, academic performance, and bystander roles, we emphasize their effects on adolescent self-esteem. Our research categorizes cyberbullying into verbal, relational, and behavioral types, distinguishes between acquaintances and strangers as perpetrators, and identifies six distinct bullying patterns.

This study assesses coping strategies adolescents might use after cyberbullying, categorizing them into passive and active responses. These mechanisms can bolster bullied adolescents' self-worth and confidence and deter bullies by highlighting potential consequences. Moreover, given the link between cyberbullying and internet use, we use propensity score matching to determine the minimum online exposure risk. Distinguishing actual victims from potential victims offers insights for educational efforts and enhancing anti-cyberbullying strategies.

Using the propensity score matching method on 1,852 Taiwanese students, we identified three primary cyberbullying risk factors: poor academics, previous bystander exposure, and anxiety traits. Gender and education level also affect the type of bullying. Known bullies affect self-esteem the most. While victims often turn to teachers, parents, peers, and platforms, they typically use passive responses. Strangers as bullies increase the chances of police reports and retaliation. The threshold for cyberbullying exposure is shorter for educational than leisure use, suggesting academic pressures in online environments can escalate cyberbullying as students use platforms more for studies.

In conclusion, this research offers a comprehensive insight into cyberbullying, aiding educators, parents, and policymakers in crafting informed strategies. By examining its types, causes, impacts, responses, and timing, this study enriches prior literature that focused on singular facets of cyberbullying. Such a holistic perspective is essential for devising impactful interventions and policies.

The remainder of this paper is organized as follows. Section 2 reviews related literature on cyberbullying. Section 3 describes the sources of data. Section 4 establishes an empirical analysis model. Section 5 provides an explanation of the empirical results. The final section presents conclusions and discussions.

2. Literature Review

Cyberbullying, unlike physical bullying, arose with the proliferation of ICTs and online platforms (Langos, 2012; Olweus, 2012; Olweus & Limber, 2018). It's now pervasive among students (Shariff & Hoff, 2007; Smith *et al.*, 2008; Cassidy *et al.*, 2009; Mishna *et al.*, 2010; Patchin & Hinduja, 2010) and a significant concern globally (Compbell, 2005; Notar et al., 2013; Craig *et al.*, 2020). This issue is also prevalent in Taiwanese schools (Huang & Chou, 2010; Lee *et al.*, 2013; Chen & Chen, 2020). Chang *et al.* (2013) identified that Taiwanese high schoolers experienced cyberbullying at over twice the rate of physical bullying. Wang *et al.* (2019) noted that 28.9% of high schoolers engaged in both cyber and physical bullying.

The alarming prevalence of cyberbullying suggests that numerous students face such harassment. Olweus (1994) characterized bullying as prolonged, intentional aggression towards victims, marked by a clear power disparity between bully and victim. This foundational definition offers subsequent researchers a distinct framework, emphasizing the behavior's persistent nature, transcending isolated incidents, and highlighting the malevolent intent to harm. Given the unequal dynamic, victims are often powerless to defend themselves or fight back effectively.

In our digital society, traditional bullying has transitioned online. Cyberbullying extends the reach and severity of harassment, occurring anywhere and anytime. Bullies often act behind perceived anonymity, making it challenging for victims to identify them. Harmful content can spread rapidly and remain online indefinitely (Smith et al., 2008). Consequently, the effects of cyberbullying can exceed those of physical bullying (Smith *et al.*, 2008; Cassidy *et al.*, 2009; Chang *et al.*, 2013; Litwiller & Brausch, 2013; Wang *et al.*, 2019). Research also shows an overlap between the two bullying forms, further magnifying its impact (Waasdorp & Bradshaw, 2015; Wang *et al.*, 2019).

The rising incidence of cyberbullying may reflect growing victim awareness. Leduc *et al.* (2022) suggest this increase results from better understanding, leading to more reporting. However, discrepancies in bullying definitions and sample choices can affect prevalence (Smith *et al.*, 2008; Cassidy *et al.*, 2009; Mishna *et al.*, 2010; Patchin & Hinduja, 2010; Sabella *et al.*, 2013; Wang *et al.*, 2019; Craig *et al.*, 2020; Zhu *et al.*, 2021). Broader definitions correlate with higher incidents (Olweus, 2012; Kowalski *et al.*, 2014). Hence, when evaluating studies, it's crucial to consider these factors and interpret them with caution (Smith *et al.*, 2008; Patchin & Hinduja, 2010; Kowalski *et al.*, 2014; Wang *et al.*, 2019).

Research has evaluated bullying within Olweus's (1994) framework. The severity of cyberbullying compared to traditional forms is widely discussed (Langos, 2012; Bonanno & Hymel, 2013; Notar *et al.*, 2013). The effects of different cyberbullying types, especially psychological harm, are central (Shariff & Hoff, 2007; Smith *et al.*, 2008; Cassidy *et al.*, 2009; Mishna *et al.*, 2010; Patchin & Hinduja, 2010; Langos, 2012; Olweus, 2012; Huang & Chou, 2013; Litwiller & Brausch, 2013; Slonje *et al.*, 2013; Berne *et al.*, 2014; Chen & Chen, 2020). Kowalski *et al.* (2014)

and Waasdorp & Bradshaw (2015) highlight the amplified effects on adolescents subjected to multiple bullying types simultaneously.

Many studies explore cyberbullying, but few focus on the perpetrators' origins. Despite the internet's anonymity, U.S. students frequently recognize their cyberbullies, often viewing them as friends (Mishna *et al.*, 2010; Patchin & Hinduja, 2010). This indicates that familiar perpetrators exploit victims' habits and weaknesses. Conversely, victims might find it challenging to confront bullying when tied to their harasser, possibly furthering the bully's goals.

Victims of cyberbullying face threats from both strangers and acquaintances. Attacks from strangers typically involve verbal bullying, stemming from the victim's online activities or the attacker's emotional outbursts (Smith *et al.*, 2008). Such bullying can induce intense fear due to the attacker's anonymity and lack of oversight (Patchin & Hinduja, 2010). In contrast, acquaintances often employ relational bullying, including rumor-spreading and exclusion (Olweus, 2012). The betrayal of trust and daily interactions with perpetrators can amplify victims' feelings of helplessness.

3. Data

This study's data comes from the Taiwan Communication Survey (TCS), sponsored by the Ministry of Science and Technology (MOST) of Taiwan. Conducted every five years, the TCS aims to understand communication technology's use and impact on Taiwanese citizens. Specifically, data from the first survey of its second term highlights personal efficacy and media usage implications. Questions related to bullying are sourced from sections on the internet and school behavior. The survey collected 1852 responses from Taiwanese adolescents for analysis. Table 1 displays the cyberbullying prevalence among these participants.

Table 1. The prevalence rate of cyberbullying victim among Taiwanese adolescents

	Victim			
	Cyberbullying	Cyber-verbal bullying	Cyber-relational bullying	Cyber-behavioral bullying
Ratio	13.1749%	9.5572%	2.4298%	4.9136%
N	1852			

Table 1 indicates that 13.1749% of Taiwanese students have encountered cyberbullying. This includes 9.5572% verbal, 4.9136% behavioral, and 2.4298% relational bullying. The data suggests that attackers aiming for evident harm might opt for more direct forms like verbal or behavioral cyberbullying. In contrast, cyber-relational bullying, involving social exclusion or status damage, tends to be subtler with delayed impacts. This may result in victims not recognizing they're being bullied, leading to underreporting. Therefore, a quantitative model will be formulated to assess Taiwanese adolescents' cyberbullying experiences.

4. Model and Empirical Method

This section introduces a micro-founded economic model to explain adolescent decisions in a cyberbullying context. The model shows how expected utilities drive bullying choices, self-assessment, and the risk of becoming a victim, which aligns with rational choice theory.

4.1 Basic Model

This study considers a set of students $i \in \{1,2,\ldots,N\}$, each deciding whether to bully or risk victimization in an online setting. For simplicity, each individual's decision is initially treated as independent, though peer effects can be included. Each student i has a utility function $U_i(\cdot)$. If i chooses to bully (Bully) or not to bully (notBully), the utilities are:

$$U_i(Bully) = V_i(Bully) - C_i(Bully) \tag{1}$$

$$U_i(notBully) = V_i(notBully) - C_i(notBully) \tag{2}$$

Here, $V_i(\cdot)$is the perceived benefit; $C_i(\cdot)$ is the associated cost. If student j is victimized:

$$U_j(Victim) = \Gamma_j - \Psi_j \tag{3}$$

where Γ_j captures external support and Ψ_j represents psychological or social harm. Let S_i denote self-assessment (self-esteem, self-satisfaction). Then:

$$U_i = U_i(Bully, S_i) \tag{4}$$

$$U_i = U_i(notBully, S_i) \tag{5}$$

with S_i influenced by bullying, victimization, and exogenous conditions.

4.2 Decision to Bully or Not

Student i's expected utility from bullying is:

$$E\left[U_i(Bully)\right] = p_{i,ns}V_i(Bully) + (1 - p_{i,ns})\left(V_i(Bully) - \kappa_i\right) - C_i(Bully) \tag{6}$$

Here, $p_{i,ns}$ is the probability of avoiding sanction, κ_i the added cost if sanctioned, and $C_i(Bully)$ the baseline cost of bullying. If i does not bully:

$$E\left[U_i(notBully)\right] = V_i(notBully) - C_i(notBully) \tag{7}$$

Student i will bully if $E[U_i(Bully)] > E[U_i(notBully)]$. Equivalently:

$$I(Bully_i) = I\left\{E\left[U_i(Bully)\right]_i > E\left[U_i(notBully)\right]\right\} \tag{8}$$

Where $I(\cdot)$ is an indicator function. From an economic perspective, the individual compares the expected "benefit minus cost" of bullying to that of not bullying; if the former is higher, the individual may become a bully.

4.3 Risk of Victimization

For student j, the likelihood of victimization depends on the group's bullying choices and personal vulnerability:

$$p_{j,Victim} = \Theta\left(BullyDecisions, \omega_j, Z_j\right) \tag{9}$$

BullyDecisions denotes others' bullying decisions; ω_j captures j's vulnerability; Z_j includes external protections. If j is not victimized, the student retains a baseline utility $U_j(Safe)$. Therefore, the expected utility is:

$$E\left[U_j\right] = p_{j,Victim}U_j(Victim) + \left(1 - p_{j,Victim}\right)U_j\left(Safe\right) \quad (10)$$
$$= p_{j,Victim}\left(\Gamma_j - \Psi_j\right) + \left(1 - p_{j,Victim}\right)U_j\left(Safe\right)$$

When all students decide simultaneously, and victims respond via protective measures, the system can reach a partial equilibrium. Equilibrium requires:

$$Bully_i^* = \arg \max_{Bully\ or\ notBully} E\left[U_i(\cdot)\right] \quad (11)$$

$$p_{j,Victim}^* = \Theta\left(BullyDecisions^*, \omega_j, Z_j\right) \quad (12)$$

$$S_i^* = f\left(Bully_i^*, Victim_i^*, X_i\right) \quad (13)$$

Here, X_i includes factors like family background or peer support. Changes in exogenous conditions can alter bullying and victimization rates.

4.4 Empirical Method

In the TCS survey, cyberbullying encompasses nine forms experienced twice or more in the past year across various digital platforms. This study categorizes it into three types. Firstly, cyber-verbal bullying entails: (1) online scolding, ridiculing, or teasing; (2) online threats or insults; (3) spreading of false rumors or derogatory words online; and (4) disclosure of private matters online.

Secondly, cyber-relational bullying refers to online exclusion from groups or activities. Cyber-behavioral bullying includes: (1) spreading filmed bullying incidents; (2) sharing private videos or photos; (3) altering login credentials for social media or email; and (4) hacking accounts to post false messages. Based on these types, bullying variables are further segmented based on the perpetrator being a friend or stranger, leading to six cyberbullying classifications. Subsequent sections discuss the relevant empirical settings.

The empirical variable settings define cyberbullying and its specific types as binary variables. A value of 1 indicates the teenager has experienced a particular cyberbullying type; 0 indicates no bullying experience. Recognizing cyberbullying as an endogenous behavior driven by individual adolescent characteristics, the determinant equation for cyberbullying occurrence is established as follows:

$$Victim_i = \alpha_0 + \alpha_1 Sex_i + \alpha_2 PoorGrades_i + \alpha_3 Bystander_i + \alpha_4 Anxiety_i \quad (14)$$
$$+\alpha_5 Schoolchilden_i + \varepsilon_i$$

The study integrates six cyberbullying categories into the $Victim_i$ variable for analysis and compares the results. Eq. (14) includes six individual characteristics: gender, poor academic performance, bystander experience, anxious personalities, and primary and secondary school students. Gender, coded 1 for males and 0 for females, is a recurrent theme in bullying research. While studies generally show males as bullies and females as victims, Barlett & Coyne (2014) observed early adolescent girls more involved in cyberbullying, with males taking on this role later. Some research indicates gender's influence on

cyberbullying differs based on the type of bullying, and Cassidy *et al.* (2009) suggest that gender distinctions in cyberbullying behavior might be ambiguous. Consequently, this study doesn't anticipate a specific direction for the gender variable's impact.

Nansel *et al.* (2001) and Mishna *et al.* (2010) linked poor academic performance to increased bullying victimization due to deficits in self-confidence, social skills, and peer support. Huang & Chou (2010), however, found no such correlation among Taiwanese junior high students, citing cultural emphasis on academic success. They acknowledged potential reliability concerns with self-reported grades. In Taiwanese contexts, students scoring below 60 may experience more criticism and increased online exposure, raising bullying risks. This study anticipates a negative coefficient for poor academic performers, suggesting a higher likelihood of cyberbullying victimization.

Olweus (1994) and Salmivalli (1999) emphasize bystanders' significant influence in bullying, where supporting victims can reduce bullying, but assisting bullies can intensify it. Leduc *et al.* (2022) found adolescents often underestimate cyberbullying's seriousness. This study redefines bystander roles, questioning if witnessing bullying makes students more prone to online victimization. The distress from observing bullying, combined with inaction, might make bystanders attractive targets. Resulting guilt and anxiety can damage self-worth and personal growth, signaling vulnerability and raising victimization chances. This research proposes that bystanders might become cyberbullying victims.

Research suggests cyberbullying increases anxiety in adolescents, impacting mental health (Shariff & Hoff, 2007; Cassidy *et al.*, 2009; Langos, 2012; Slonje *et al.*, 2013), mirroring trends in traditional bullying (Olweus, 2012). Studies by Smith *et al.* (2008) and Wang *et al.* (2019) show both victims and bullies experience elevated anxiety, and roles can shift. This indicates anxiety, while often resulting from bullying, may influence bullying patterns. Highly anxious individuals, sensitive to others' views, might be more susceptible to bullying, which intensifies cyberbullying due to the bully's constant access to victim responses.

This study introduces a dummy variable distinguishing elementary and junior high students from high schoolers in cyberbullying contexts. Younger students' limited cognitive development and online safety awareness might make them more vulnerable to cyberbullying. Their psychological immaturity and lower retaliation likelihood may attract bullies. Chen & Chen (2020) and Tokunaga (2010) observed reduced cyberbullying vulnerability with age, though the findings were specific to certain age groups. In contrast, Waasdorp and Bradshaw (2015) suggest older students' heightened online presence might increase cyberbullying exposure. This highlights the multifaceted relationship between age, educational level, and cyberbullying risk, potentially shaped by diverse online activities and developmental stages.

This study employs the Propensity Score Matching Method (PSM), utilizing a Logit model to estimate propensity scores for adolescents' cyberbullying likelihood based on eq. (14). The sample, consisting of non-bullied respondents, is

bifurcated into those never at bullying risk and those potentially at risk but unharmed to date. Including the former could bias the results. Hence, the caliper matching method in PSM is adopted to augment empirical efficiency. A minuscule threshold is preset; if an unbullied adolescent's estimated propensity score is proximal to the bullying propensity score (below the threshold), they're deemed potential victims due to analogous characteristics with bullied individuals. If the propensity score difference exceeds the threshold, the adolescent significantly diverges from bullied individuals and is excluded from the second-stage estimation.

Under these assumptions, let Pr_{Victim} and $Pr_{nonVictim}$ denote the propensity scores for being cyberbullied and not being cyberbullied, respectively. With a very small threshold of 0.0001, the conditions for selecting non-victims (the control group) to match those who have been cyberbullied (treated group) are:

$$Control\ group = \left\{ \Pr_{nonVictim} \middle| \left\| \Pr_{Victim} - \Pr_{nonVictim} \right\| < Caliper = 0.0001 \right\} \tag{15}$$

In addressing the outlined issue, this study employs adolescents' self-esteem ($SelfSatisfication_i$) as a metric to gauge the impact of cyberbullying, a pressing concern during their crucial stage of social networking and personality growth, given its tight link to self-esteem. As victims, adolescents may harbor negative self-views, skills, and social standing post-cyberbullying, potentially diminishing their self-esteem. Prolonged low self-esteem and confidence can segue into mental health problems. Hence, the impact on self-esteem is represented as:

$$SelfSatisfication_i = Victim_i SelfSatisfication_{1i} + \left(1 - Victim_i\right) SelfSatisfication_{0i} \tag{16}$$

$SelfSatisfication_{1i}$ and $SelfSatisfication_{0i}$ represent the effects on self-esteem under actual and potential types of bullying, respectively. The difference between them corresponds to the Average Treatment Effect on the Treated (ATT) as described by Rosenbaum & Rubin (1983) and Dehejia & Wahba (2002). It may be expressed as:

$$\begin{aligned} ATT &= E\left(SelfSatisfication_{1i} - SelfSatisfication_{0i} \middle| Victim_i = 1\right) \\ &= E\left(SelfSatisfication_{1i} \middle| Victim_i = 1\right) - E\left(SelfSatisfication_{0i} \middle| Victim_i = 1\right) \end{aligned} \tag{17}$$

Moreover, this study delves into adolescents' reactions post-exposure to diverse bullying types, classifying responses into passive and active modes. Passive responses encompass (1) message avoidance or dismissal; (2) message deletion or blocking; and (3) digital withdrawal, like account alteration or platform departure, all sidestepping direct confrontation. Conversely, active responses entail (1) urging cessation; (2) notifying teachers, parents, peers, or online platforms; (3) contacting law enforcement; and (4) retaliating, aiming for direct issue resolution and external assistance. The caliper matching method remains the empirical analysis tool, with dependent variables as response modes to discern the likelihood of specific response adoption post-cyberbullying encounter.

Following the filtering of matched samples, this study distinguishes cyberbullying victims from potential victims, highlighting a positive correlation between cyberbullying incidents and internet engagement. Increased online duration elevates potential bullying encounters, notably among adolescents with underdeveloped social skills, whose naive online interactions might incite

cyberbullying. Furthermore, excessive internet use may degrade real-world social skills, rendering adolescents more susceptible to cyberbullying. This analysis estimates online interaction duration, endeavoring quantitatively to pinpoint the leisure and academic use threshold predisposing to bullying—a significant insight for adolescents under parental or educational supervision concerning online time.

5. Empirical Results

5.1 Analysis of Behavioral Determinants in Cyberbullying Victimization

Table 2 presents determinants linking adolescents to cyberbullying vulnerability, including poor academic performance, witnessing bullying, and anxiety traits. Students with perceived subpar academic results face a 3.7% elevated risk of cyberbullying. In academically driven cultures like Taiwan, underperforming students may experience heightened criticism, reducing resilience. Their online presence, seeking academic or social aid, may also increase their exposure to bullying.

Table 2. The empirical results of determinants of cyberbullying victim among Taiwanese adolescents

	Cyberbullying Victim
Sex_i	0.1958 [a]
	[0.0160] [b]
	(1.30)[c]
$PoorGrades_i$	0.4694***
	[0. 0370]
	(2.94)
$Bystander_i$	1.9999***
	[0.2427]
	(10.51)
$Anxiety_i$	0.0607***
	[0. 0049]
	(5.46)
$Schoolchildren_i$	-0.339
	[-0. 0027]
	(-0.21)
Pseudo R^2	0.1755
N	1810

a. Coefficient; b. Marginal effect; c. t value; d. *** represent statistical significance at the 1%; e. The empirical results include a constant term.

Students who have previously witnessed bullying have a 24.27% increased likelihood of becoming targets. Observing bullying can cause significant stress and discomfort. Choosing not to intervene might label them as passive, leading bullies to believe they won't report any future incidents. This perception is especially prevalent among younger students. The guilt of not acting against bullying can affect their self-worth. If bullies detect this lowered self-esteem, these students' risk of victimization escalates.

Students identifying with an anxious personality, compared to psychologically normal peers, experience a marginal 0.49% increase in cyberbullying likelihood, a

statistically significant outcome. Such anxiousness often stems from irregular, prolonged internet use, making them easier targets online. They appear vulnerable, introverted, and lack self-confidence, making them more susceptible to bullies who exploit these traits to intensify their bullying, enhancing their sense of power and control.

5.2 Analysis of Detailed Types of Cyberbullying Victimization

Cyberbullying encompasses verbal, behavioral, and relational forms. Analysis indicates that the victim's knowledge of their bullies intensifies their impact. The anonymity of the internet emboldens bullies due to its reduced consequences. Especially among school students, limited internet rule understanding allows even acquaintances to bully. Traditional social ties, like family and school, differ from volatile online relationships, increasing cyberbullying vulnerability.

Table 3 indicates male students face a higher risk of verbal, behavioral, and cyber-relational bullying by strangers, with increased likelihoods of 1.37%, 0.72%, and 1.46%, respectively. This could be due to males' involvement in competitive online activities, drawing stranger aggression. While physical attributes and societal norms might deter offline confrontations, they don't apply online, possibly causing real-world retaliation by male students, raising their risk of cyberbullying from strangers.

Table 3. The empirical results of determinants of various types of cyberbullying victim among Taiwanese adolescents

	Cyber-verbal bullying			Cyber-relational bullying			Cyber-behavioral bullying		
	Victim	Victim by acquaintance	Victim by stranger	Victim	Victim by acquaintance	Victim by stranger	Victim	Victim by acquaintance	Victim by stranger
Sex$_i$	0.0750[a] [0.0036][b] (0.43)[c]	-0.3442 [-0.0067] (-1.46)	0.8877** [0.0137] (2.47)	0.5494 [0.0069] (1.62)	-0.6602 [-0.0011] (-0.99)	2.3910** [0.0072] (2.33)	0.3939* [0.0167] (1.76)	-0.2185 [-0.0012] (-0.39)	0.5630** [0.0146] (1.96)
PoorGrades$_i$	0.4467** [0.0210] (2.38)	0.5333** [0.0100] (2.07)	0.6253* [0.0089] (1.69)	0.5713* [0.0067] (1.64)	0.3739 [0.0006] (0.64)	1.0585 [0.0023] (1.25)	0.2619 [0.0107] (1.13)	-0.4152 [-0.0024] (-0.70)	0.2728 [0.0068] (0.92)
Verbal-Bystander$_i$	2.3691*** [0.2103] (9.56)	2.5169*** [0.1065] (6.40)	1.1647*** [0.0239] (2.65)						
Relational-Bystander$_i$				2.7052*** [0.1344] (3.22)	2.5890 [0.0182] (1.38)	2.3372 [0.0197] (1.20)			
Behavioral-Bystander$_i$							1.1133** [0.0745] (2.48)	-0.1252 [-0.0006] (-0.12)	0.8586 [0.0320] (1.44)
Anxiety$_i$	0.0761*** [0.0037] (5.60)	0.0865*** [0.0017] (4.34)	0.0155 [0.0002] (0.66)	0.0941*** [0.0011] (4.03)	0.1258* [0.0002] (1.69)	0.0021 [0.000006] (0.05)	0.0346** [0.0014] (2.21)	0.0967*** [0.0005] (2.68)	0.0004 [0.00001] (0.02)
Schoolchildren$_i$	0.0978 [0.0047] (0.52)	0.3976 [0.0079] (1.55)	-0.7510** [-0.0112] (-2.01)	0.7535** [0.0097] (2.00)	3.0023** [0.0076] (2.47)	-0.3712 [-0.0008] (-0.52)	-0.0461 [-0.0019] (-0.20)	0.4744 [0.0026] (0.81)	-0.5597* [-0.0142] (-1.87)
Pseudo R^2	0.2223	0.2320	0.0712	0.2019	0.2816	0.1388	0.0367	0.0392	0.0258
N	1822	1835	1850	1842	1846	1850	1840	1851	1851

a. Coefficient; b. Marginal effect; c. t value; d. ***, ** and * represent statistical significance at the 1%, 5% and 10%, respectively; e. The empirical results all include a constant term.

Poor academic performance increases the likelihood of students facing verbal and relational bullying by 2.10% and 0.67%, respectively, with a higher chance of verbal bullying from acquaintances (1%) than strangers (0.89%). In Taiwanese schools, academic performance, a key marker of status, is well-known among peers. A performance decline may lower peer status, making students aggressive targets. They might face negative stereotypes like laziness or incapability, making them prone to peer ridicule. This, coupled with potential social estrangement and diminished self-esteem, enhances their bullying vulnerability, especially as poor performance may alter their self-perception of abilities and value, leaving them feeling powerless against bullying.

Poor academic performance raises students' risk of verbal and relational bullying by 2.10% and 0.67%, respectively, with acquaintances posing a higher verbal bullying threat (1%) than strangers (0.89%). In Taiwanese schools, peers often recognize academic standing. A drop in performance can reduce peer status, making students bullying targets. This may lead to stereotypes, such as laziness, making them susceptible to peer mockery. Combined with potential social isolation and low self-esteem, their vulnerability increases, especially when poor grades impact their self-worth, rendering them defenseless against bullying.

Previous bystanders to verbal, relational, and cyber-behavioral bullying see their likelihood of being targeted increase by 21.03%, 13.44%, and 7.45%, respectively, with the probability of verbal bullying by acquaintances and strangers rising by 10.65% and 2.39%, respectively. This may arise from the bystander's "implied consent," where their silence or non-opposition could be seen as bullying acceptance, making them the next target. Choosing not to assist due to social status concerns or perceived incident irrelevance may expose bystanders to retaliation from former victims, creating a vicious bullying cycle with bystanders becoming new victims.

Table 1 correlates internet-anxious traits with increased cyberbullying victimization. Table 2 further demonstrates that such students face higher risks of verbal, relational, and cyber-behavioral bullying, with victimization chances rising by 0.37%, 0.11%, and 0.14%, respectively. Data suggests internet anxiety contributes more to cyberbullying by acquaintances in verbal (0.17%), relational (0.02%), and behavioral (0.05%) categories than by strangers. Acquaintance-driven cyberbullying leverages shared knowledge to exploit victims' weak spots. Targeting internet-anxious individuals, who may overexpress emotions online, results in intensified bullying.

Students with internet anxiety, potentially lacking social skills, may depend excessively on the internet for social interaction. This dependence, combined with poor coping mechanisms, can heighten their anxiety when cyberbullied. Known perpetrators may exploit the victims' vulnerabilities for dominance, while stranger-perpetrated cyberbullying is less evident, possibly due to limited victim knowledge or concerns about reputation and legality. Although this study highlights this trend, it doesn't negate stranger cyberbullying, emphasizing the need for ongoing prevention and awareness.

Compared to high school students, elementary and middle school students face higher chances of cyber-relational bullying by acquaintances, with a 0.97% and 0.76% increase, respectively. Their limited psychological maturity and social skills might lead to poor coping mechanisms and misunderstandings, especially with known individuals, escalating cyberbullying. Peer pressure may push them to subdue assertiveness, increasing vulnerability. Their weaker grasp of digital literacy compared to older students might also heighten their online bullying risk.

High school students have a higher risk of cyber-verbal and cyber-behavioral bullying by strangers, increasing by 1.12% and 1.42%, respectively, compared to younger students. This might result from more time online and increased interactions with strangers. Given their stage of self-identification and sensitivity to external judgments, their reaction to cyberbullying can be more pronounced. This emphasizes the importance of extending cyber safety measures to high school students, promoting digital literacy, and providing psychological support to mitigate their specific cyberbullying risks.

5.3 Analysis of the Impact of Cyberbullying Victimization

Using the caliper matching method, we assessed the effect of cyberbullying on adolescent self-esteem. Table 4 indicates a 26.23% decrease in self-esteem after cyberbullying. Specific types, such as linguistic, interpersonal, and cyber-behavioral bullying, result in self-esteem reductions of 21.08%, 22.85%, and 29.11%, respectively. Behavioral bullying by acquaintances causes a significant 41.55% decline. Table 3.3, utilizing the same method, highlights the self-esteem disparity between victimized adolescents and others, emphasizing cyberbullying's substantial negative impact on Taiwanese adolescents' self-esteem.

Table 4. The impacts of cyberbullying on the self-esteem level of Taiwanese adolescents

	Self-esteem level
Cyberbullying	-0.2623***
	(-5.08)
Cyber-verbal bullying	-0.2108***
	(-3.36)
Cyber-verbal bullying by acquaintance	-0.2500***
	(-2.97)
Cyber-verbal bullying by stranger	-0.1081
	(-0.93)
Cyber-relational bullying	-0.2285*
	(-1.88)
Cyber-relational bullying by acquaintance	-0.3000
	(-1.41)
Cyber-relational bullying by stranger	-0.1107
	(-0.70)
Cyber-behavioral bullying	-0.2911***
	(-4.27)
Cyber-behavioral bullying by acquaintance	-0.4166**
	(-2.35)

	Self-esteem level
Cyber-behavioral bullying by stranger	-0.2830*** (-3.35)

a. Average treatment effect on the treated (ATT); b. t value; c. ***, ** and * represent statistical significance at the 1%, 5% and 10%, respectively.

Cyberbullying significantly lowers self-esteem due to the humiliation and helplessness it causes. When aggressors are within the victim's social circle, the damage is more profound, leading to lost confidence and increased self-doubt. The persistent nature of the internet can magnify this harm, with shared bullying content potentially isolating victims and adding social pressure. This can result in serious mental health issues, including anxiety and depression. Moreover, as students' primary focus is studying, cyberbullying can disrupt their academic performance, reinforcing a detrimental cycle of declining self-esteem.

Adolescent self-esteem profoundly impacts mental health, relationships, academic success, and resilience. It's linked with self-efficacy, promoting a positive approach to challenges. Elevated self-esteem supports a balanced psychological state, reducing the risk of disorders like anxiety. It also enhances an adolescent's ability to maintain healthy social relationships. Thus, addressing bullying is vital for educators and parents to ensure a nurturing environment for adolescents.

5.4 Analysis of Coping Strategies After Cyberbullying Victimization

Previous analyses underscored the detrimental effects of cyberbullying, suggesting that victims employ coping strategies. Table 5 shows the probabilities of three negative and four positive coping responses to different cyberbullying forms. Most coefficients are statistically significant, indicating that Taiwanese adolescents have varied coping probabilities based on the type of cyberbullying experienced.

Table 5. The empirical results of coping strategies after being cyberbullied

	Passive coping strategies			Active coping strategies			
	No dealing with or ignoring	Deleting or blocking messages	Staying offline, changing accounts, or leaving the internet platform	Asking others to stop their behavior	Informing teachers, parents, classmates, friends, internet companies	Calling the police	Fighting back
Cyberbullying	0.3762a*** (11.01)b	0.3663*** (10.78)	0.3415*** (10.21)	0.3168*** (9.65)	0.4900*** (13.90)	0.0643*** (3.72)	0.1138*** (5.08)
Cyber-verbal bullying	0.4217*** (9.52)	0.3333*** (8.14)	0.2312*** (5.60)	0.3265*** (8.41)	0.4897*** (11.38)	0.0408** (2.49)	0.1360*** (4.80)
Cyber-verbal bullying by acquaintance	0.4210*** (7.00)	0.2368*** (4.44)	0.1842*** (3.72)	0.3026*** (5.71)	0.5394*** (9.37)	0.0263 (1.42)	0.0921*** (2.76)
Cyber-verbal bullying by stranger	0.4351*** (5.36)	0.3374*** (4.27)	0.2900*** (3.79)	0.2933*** (3.83)	0.3457*** (4.32)	0.0674 (1.56)	0.2373*** (3.35)
Cyber-relational bullying	0.3428*** (4.57)	0.3742*** (4.96)	0.3523*** (4.67)	0.3196*** (4.32)	0.4083*** (5.32)	0.1355** (2.47)	0.2309*** (3.54)
Cyber-relational bullying by acquaintance	0.3954** (2.33)	0.2891** (2.28)	0.3539*** (2.73)	0.2305* (1.90)	0.4583*** (3.52)	0.1185 (1.38)	0.1141 (1.32)
Cyber-relational bullying by stranger	0.4050*** (2.57)	0.2077 (1.47)	0.3788** (2.40)	0.3916** (2.48)	0.3650** (2.31)	0.3496** (2.30)	0.3410** (2.24)
Cyber-behavioral bullying	0.2393*** (4.99)	0.4163*** (7.89)	0.5016*** (9.51)	0.3302*** (6.49)	0.4321*** (8.16)	0.1026*** (3.11)	0.0520* (1.73)
Cyber-behavioral bullying by acquaintance	0.1017 (0.98)	0.4929*** (3.42)	0.4196*** (2.91)	0.3460** (2.46)	0.5553*** (3.95)	0.0677 (0.88)	0.2123* (1.75)
Cyber-behavioral bullying by stranger	0.2264*** (3.05)	0.3396*** (4.81)	0.5660*** (8.24)	0.3396*** (5.17)	0.4528*** (6.19)	0.1509*** (3.04)	0.0377 (0.95)

a. Average treatment effect on the treated (ATT); b. t value; c. ***, ** and * represent statistical significance at the 1%, 5% and 10%, respectively.

After experiencing cyberbullying, adolescents often report it to teachers, parents, peers, and internet companies, driven by feelings of vulnerability. With a 49% chance of students confiding in trusted individuals, they primarily seek support from their social networks, reaffirming their belief in social justice and maintaining self-worth. Reporting to adults helps prevent further bullying, while sharing with peers can correct false narratives. They may also ask internet companies to remove offensive content, underscoring the companies' responsibility to protect users.

When cyberbullied, students mainly use three negative coping strategies, with likelihoods ranging from 34.15% to 37.62%. Apart from informing trusted individuals, 31.68% request the bully to cease, a mere 6.43% contemplate police involvement, and 11.38% consider retaliation. These choices highlight their post-bullying concerns, such as fearing increased retaliation, not wanting to appear weak, believing the bullying isn't serious enough for intervention, and younger students' unfamiliarity with options like reporting, leading to passive reactions.

The study reveals that the type of bullying dictates victims' coping mechanisms. Verbal bullying victims mainly turn to teachers, parents, peers, and internet companies (48.97%) or opt for inaction (42.17%). Those facing relational bullying

often seek similar help (40.83%) or delete messages and block the bully (37.32%). Behavioral bullying victims tend to avoid the internet or alter accounts (50.16%), but still commonly reach out for support (43.21%). Overall, contacting teachers, parents, peers, and internet companies is a common response, with other methods varying based on the type of bullying.

Students frequently choose to disregard verbal cyberbullying, possibly due to the internet's anonymity or viewing such attacks as fleeting and harmless. They might internally hope these attacks will diminish with time, while externally fearing that confrontation could worsen the situation. Consequently, they may perceive such bullying as a normal adolescent ordeal and remain silent to prevent escalation.

The study centers on adolescents valuing peer relationships. In response to online relational bullying, they typically delete or block bullying messages to prevent peers from viewing them, essentially preserving their social image. Blocking also stops further hurtful messages, alleviating the psychological strain on the victim.

In reaction to online behavioral bullying, students frequently avoid the internet, change accounts, or leave platforms. This denotes a self-preservation approach, aiming to decrease further aggression. By switching accounts, they hope to shield their identity and deter bullies. These measures highlight victims' attempts to manage their online environment and find safer social spaces. Although coping methods vary depending on the type of bullying, they often provide only short-term relief without tackling the core issues of cyberbullying, leaving foundational problems unaddressed.

Victims of cyberbullying by acquaintances frequently report to teachers, parents, peers, or online platforms. The response rates for verbal, relational, or behavioral bullying are 53.94%, 45.83%, and 55.53%, respectively. This is due to decreased anonymity with known bullies. Reporting serves as both a means of seeking support and deterring bullies by emphasizing potential consequences, such as school penalties, parental actions, peer ostracization, or platform sanctions.

Victims of verbal and relational bullying by acquaintances often react with inaction, at rates of 42.10% and 39.54%. For behavioral bullying, 49.29% chose to delete messages or block the bully. Such passive responses may arise from fears of escalation and the emotional complexities of confronting known bullies. Concerns about damaging the relationship or perceiving the bullying as temporary can drive victims toward passive coping.

For verbal and relational bullying by strangers, 43.51% and 40.5% of victims often ignore it, respectively. In behavioral cases, 56.6% use avoidance strategies like platform exit. Victims are more inclined towards active coping against strangers, especially in relational bullying, with reporting or retaliating rates at 34.96% and 34.1%, respectively, compared to lower rates for acquaintance bullying. This indicates that, absent interpersonal ties, victims more assertively address stranger-bullying to deter future occurrences.

5.5 Analysis of Internet Usage Time in Relation to the Formation and Potential of Cyberbullying

Adolescents, seeking identity and social acceptance, turn more to the internet and social platforms. However, this amplifies their cyberbullying risk due to the vast reach of the internet and ICTs. Table 6 examines this relationship, presenting daily online interaction durations for cyberbullying victims. The table displays time thresholds, with the first parentheses showing the minute difference in daily online interaction between actual and potential incidents, and the second providing the *z*-value for significance evaluation.

Table 6. The threshold of online interaction time required for cyberbullying

	The minutes of online interaction per day	
	For leisure	For educational purposes
Cyberbullying	120.4307***	56.5891***
	[27.7565][a]	[8.1861]
	(4.24)[b]	(2.12)
Cyber-verbal bullying	123.1361***	55.4081
	[29.4966]	[6.6380]
	(3.89)	(1.49)
Cyber-verbal bullying	115.1316*	49.9342
by acquaintance	[19.4539]	[0.4532]
	(1.87)	(0.07)
Cyber-verbal bullying	147.2703***	67.0270**
by stranger	[51.8334]	[17.7501]
	(3.54)	(2.06)
Cyber-relational bullying	138.3143***	61.6571
	[42.4078]	[12.3062]
	(2.81)	(1.39)
Cyber-relational bullying	92.0000	47.8000
by acquaintance	[-4.7015]	[-1.8944]
	(-0.16)	(-0.11)
Cyber-relational bullying	172.2222***	84.6666**
by stranger	[76.0321]	[35.2017]
	(2.57)	(2.03)
Cyber-behavioral bullying	118.3924**	59.4430*
	[22.8450]	[10.3851]
	(2.24)	(1.74)
Cyber-behavioral bullying	179.9167***	45.0000
by acquaintance	[83.9585]	[4.6786]
	(3.28)	(0.31)
Cyber-behavioral bullying	104.3019	65.2075**
by stranger	[8.0126]	[15.9622]
	(0.64)	(2.20)

a. The gap in online interaction time between actual and potential victims; b. t value; c. ***, ** and * represent statistical significance at the 1%, 5% and 10%, respectively.

Students spend less time online for education (56.5891 minutes) than leisure (120.4307 minutes). However, these times exceed those of potential cyberbullying victims by 8.1861 and 27.7565 minutes, respectively. The shorter threshold for educational use suggests a greater cyberbullying risk, possibly due to increased peer interactions for school tasks. In less-monitored environments, bullies may find opportunities. High achievers, due to academic disparities, can be targets of envy. In Taiwan, where academic success is emphasized, such disparities might heighten peer tensions, making top students more vulnerable to bullying.

Cyberbullying during online educational activities is more prevalent, with shorter time thresholds than leisure use. The most notable findings involve verbal, relational, and behavioral bullying by unknown culprits, with educational time thresholds at 67.027, 84.6666, and 65.2075 minutes, respectively. Adolescents may lack real-world support when engaging with strangers online, increasing their vulnerability to stranger-perpetrated bullying and its emotional effects. Meanwhile, acquaintances might limit bullying due to fear of offline repercussions or negative perceptions stemming from existing relationships.

Table 6 shows that longer internet use is linked to a higher chance of cyberbullying. The specific time thresholds vary depending on the type of cyberbullying. Educational internet use averages about an hour, while leisure use is longer. Without adequate online guidelines, adolescents risk exposure to different forms of bullying.

6. Discussions and Conclusions

6.1 Discussions

This study, employing the Propensity Score Matching Method, offers a nuanced exploration of Taiwanese adolescents' cyberbullying victimization, enhancing our understanding of its impact. Further, categorizing cyberbullying types and distinguishing between perpetrator identities gives a clearer view of the challenges faced by adolescents. The risks of cyberbullying are linked to gender, academic performance, bystander history, and anxiety. These insights are crucial for devising and implementing improved prevention and intervention strategies in schools.

Cyberbullying significantly impacts victims' self-esteem, potentially harming their mental health and personal growth. Schools should prioritize this issue and actively address it. While nearly half of the victims disclose their experiences and seek help, many opt for avoidance. This underscores the importance of bolstering adolescents' self-awareness, reporting mechanisms, and coping skills regarding cyberbullying.

The threshold for cyberbullying risk indicates that recreational internet use exceeds educational use. Roughly an hour of daily educational internet use and excessive leisure use can increase the risk of cyberbullying. This underscores the importance of reevaluating adolescents' online habits and emphasizes the need for effective guidance and supervision of their internet activities.

Given the research findings, this article urges society, schools, and families to prioritize addressing cyberbullying. Unlike traditional bullying, cyberbullying isn't

confined by time or space and can occur asynchronously. This necessitates bolstering internet literacy education, enhancing adolescent self-awareness and protective measures, and offering prompt psychological support. A collaborative effort between parents, schools, and the broader community is essential to creating a secure and positive online environment for adolescents.

6.2 Conclusions

This study provides a comprehensive analysis of adolescent cyberbullying in Taiwan, utilizing official government data. Distinctly, it employs the Propensity Score Matching Method to distinguish between actual victims and potential victims with similar propensity scores but no cyberbullying experience, refining the study's accuracy. It also categorizes cyberbullying into types, such as verbal, relational, and behavioral, and identifies the bully as either an acquaintance or stranger, offering nuanced insights into the online challenges faced by adolescents.

The results show that being male, poor academic performance, prior bystander experience in cyberbullying, and an anxious personality are the main risk factors for verbal, relational, and cyber-behavioral bullying among adolescents. These variables remain significant regardless of whether the bully is an acquaintance or a stranger. Primary and junior high students mainly experience relational bullying from acquaintances, whereas high school students predominantly face verbal and behavioral bullying from strangers.

Taiwanese adolescents' self-esteem significantly decreases after experiencing cyberbullying. Victims see a 26.23% greater reduction in self-esteem compared to potential victims. Different bullying types result in varying self-esteem declines, with cyber-behavioral bullying by acquaintances causing a notable 41.66% drop. This highlights the severe impact of cyberbullying on Taiwanese adolescents' personal development.

There's a negative relationship between cyberbullying and adolescent self-esteem. As expected, 49% of victimized students are likely to share their experiences, seeking support from teachers, parents, peers, and internet companies. Yet, many students primarily adopt passive responses like avoidance. Only when facing cyber-relational bullying by strangers do they lean towards proactive actions, such as confronting the bully, reporting to authorities, or retaliating.

This study evaluates the internet usage time thresholds at which adolescents face different types of cyberbullying. Findings show adolescents spend more online time for leisure than education. However, educational internet use is more prone to cyberbullying, particularly from strangers. Extended internet use also exposes adolescents to a broader range of cyberbullying behaviors.

Compliance with Ethical Standards

Disclosure of Potential Conflicts of Interest

The author declares that they have no conflicts of interest to disclose.

Research Involving Human Participants and/or Animals
This study did not involve any research with human participants or animals.

Informed Consent
Not applicable, as this study did not involve human participants.

Data Availability Statement
The data used in this study were obtained from the Taiwan Communication Survey (TCS), conducted by the Ministry of Digital Affairs, Executive Yuan, Taiwan. The dataset is publicly accessible and can be freely used for research purposes. Researchers can download the data from the official website of the Taiwan Communication Survey at
https://crctaiwan.dcat.nycu.edu.tw/annualsurvey_e.asp

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