ORIGINAL ARTICLE

Self-harm and its association with internet addiction and internet exposure to suicidal thought in adolescents

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Background/Purpose: Self-harm (SH) is a risk factor for suicide. We aimed to determine whether internet addiction and internet exposure to confided suicidal ideation are associated with SH in adolescents.
Methods: This study was a cross-sectional survey of students who self-completed a series of online questionnaires including a sociodemographic information questionnaire, questionnaire for suicidality and SH, Chen Internet Addiction Scale (CIAS), Patient Health Questionnaire (PHQ-9), multi-dimensional support scale (MDSS), Rosenberg self-esteem scale (RSES), Alcohol Use Disorder Identification Test-Consumption (AUDIT-C), and questionnaire for substance abuse.
Results: A total of 2479 students completed the questionnaires (response rate = 62.1%). They had a mean age of 15.44 years (range 14–19 years; standard deviation 0.61), and were mostly female (*n* = 1494; 60.3%). The prevalence of SH within the previous year was 10.1% (*n* = 250). Among the participants, 17.1% had internet addiction (*n* = 425) and 3.3% had been exposed to suicidal content on the internet (*n* = 82). In the hierarchical logistic regression analysis, internet addiction and internet exposure to suicidal thoughts were both significantly related to an increased risk of SH, after controlling for gender, family factors, exposure to suicidal thoughts in the real life, depression, alcohol/tobacco use, concurrent suicidality, and perceived social support. However, the association between internet addiction and SH

weakened after adjusting for the level of self-esteem, while internet exposure to suicidal thoughts remained significantly related to an increased risk of SH (odds ratio = 1.96; 95% confidence interval: 1.06–3.64).

Conclusion: Online experiences are associated with SH in adolescents. Preventive strategies may include education to increase social awareness, to identify the youths most at risk, and to provide prompt help.

1. Introduction

Self-harm (SH) is a term used to describe all intentional acts of self-poisoning or self-injury in many European countries, irrespective of the presence of suicidal intention. This phenomenon is important to understand because repetition of SH is frequent and an independent risk factor for suicide, although many acts of SH in adolescents begin with non-suicidal intentions.[1] Longitudinal studies following up SH in adolescents found that individuals with acts of SH have an overall four-fold excess death rate compared with the expected rate (suicide being the main reason for this increased risk),[2] and an increased rate of having a psychiatric disorder in young adulthood.[3]

The risk factors for SH in adolescents are multifactorial and often intercorrelated. A systematic review of risk factors for adolescent SH indicated that adolescents with nonfatal SH have similar characteristics to those of adolescents who completed suicide.[4] Among the identified factors, exposure to suicide (either clustering of suicides/contagion of suicidal behavior or media influence) is considered to be more influential on adolescents than adults.[5,6] Exposure to nonfatal suicidal behaviors in family and friends is found to be predictive of SH in adolescents.[7] However, little is known about the relationship between exposure to confided suicidal thoughts from others, particularly in the unique social context created by the internet, and a teenager's self-harmful behavior at the community level.

Internet addiction is characterized as a maladaptive pattern of internet use leading to clinically significant impairment or distress.[8] It includes a preoccupation with internet activities, recurrent failure to resist the impulse to use the internet, tolerance, withdrawal, use of the internet for a period of time longer than intended, persistent desire and/or unsuccessful attempts to cut down or reduce internet use, excessive time spent on internet activities and leaving the internet, excessive effort spent on activities necessary to obtain access to the internet, and continued heavy internet use despite knowledge of having a persistent or recurrent physical or psychological problem likely to have been caused or exacerbated by internet use.[9] Previous studies have found that adolescents with internet addiction have a higher level of attention deficit hyperactivity disorder symptoms, depression, and hostility, and an increased risk of engaging in aggressive behaviors.[10,11] However, little is known about the association between internet addiction and SH in adolescents. More research examining this relationship and the possible underlying mechanism is needed in order to appropriately identify and manage SH in adolescents.

In this study, our aim was to examine the relationship of SH in adolescents to internet exposure to confided suicidal ideation from others. We also tried to clarify the relationship of internet addiction to SH in adolescents, by controlling the effects of depression, concurrent suicidality, exposure to confided suicidal ideation, substance use, specific family factors, perceived social support, and self-esteem.[4,12] For those who have harmed themselves, we further looked at the differences in the number of acts and suicide intent, and whether the methods of SH researched on the internet differed between internet addicted and nonaddicted adolescents. The characteristics of SH-related experiences were explored by examining internet exposure to suicidal thoughts.

2. Methods

2.1. Study design and sample

This study was a cross-sectional survey carried out in Taipei City and Taipei County from October 2008 to January 2009. There were 13 participating senior high schools (8 urban, 3 suburban, and 2 rural schools according to Taiwan-Fukien Demographic Fact Book[13]). All of the participating schools were equipped with classroom computing facilities, which the students utilized for self-completion of online questionnaires.

The recruitment was performed by a master's level research assistant, without any involvement of school staff, to avoid the risk of coercion. The research assistant carefully explained the aims and procedures of this study, emphasized the confidentiality issues, and obtained the participants' written informed consents. A letter was given to parents asking for their permission and their written response was brought back by the participating students. Ethical approval of this study was obtained from the Institutional Review Board of MacKay Memorial Hospital prior to recruitment.

2.2. Measurement

The online questionnaire was interactive with skip pattern design and took about 30 minutes to complete. The total number of items for each respondent depended on the respondent's answers. The following information was obtained.

2.2.1. Sociodemographic information

This included education grade (all were in the first grade of high school in this study), age, gender, religion, family financial situation ascertained by asking "Is it difficult for your family to maintain basic needs (e.g., food, clothes, shelter, etc.?)", people whom they live with ("Do you currently live with both of your biological parents?"), and family harmony ("Do you think there is great discord in your family's relationships?").

2.2.2. Questionnaire for suicidality and SH

Information was collected, using standard questions, on the presence of suicidal ideation, suicide plans, and SH behavior within the previous year, including the number of SH acts, whether they consulted any internet site about SH methods, whether suicide intent was present when they tried to harm themselves ("During any of these episodes did you really want to kill yourself?"), and whether they had been exposed to others' suicidal thoughts in the real world ("Has anyone you know personally ever mentioned or discussed thoughts about killing themselves with you?") and on the internet ("Have you ever been in a situation where someone who you have met only on the internet discussed thoughts about killing themselves with you?") within the previous year. All the questions were made according to our research interest, and confirmed through a focus group process.

2.2.3. Chen Internet Addiction Scale

The 26-item Chen Internet Addiction Scale (CIAS) was used to assess the presence of internet addiction and was evaluated on a four-point Likert scale, with a total score ranging from 26 to 104. The psychometric properties of the scale were examined and the internal reliability ranged from 0.79 to 0.93.[14] Based on the Diagnostic Criteria of Internet Addiction for Adolescents,[9] adolescents scoring 64 or more on the CIAS were diagnosed as having internet addiction. The diagnostic accuracy was 87.6%.[15]

2.2.4. Patient Health Questionnaire

The Patient Health Questionnaire (PHQ-9) is a nine-item self-report inventory based on Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV) criteria for diagnosing depression, assessing severity, and monitoring treatment response.[16] The Chinese version of the PHQ-9 had good internal consistency (alpha = 0.84) and acceptable test-retest reliability (ICC = 0.80) in adolescent populations.[17] Using the Kiddie-Schedule for Affective Disorder and Schizophrenia (Epidemiological Version) as the criterion standard, a PHQ-9 score ≥ 15 had a sensitivity of 0.72 and a specificity of 0.95 for recognizing major depressive disorder in adolescents.[17]

2.2.5. Multi-Dimensional Support Scale

Multi-Dimensional Support Scale (MDSS) is a self-report measure of the availability and adequacy of social support from various sources.[18] It can be tailored to the specific needs of different research projects. Here we divided adolescents' social support into four sources (i.e., parents, other family, friends, and teachers). The Chinese version of this scale was not available at the time of this study; it was translated into Chinese by the author, with independent back-translation by a bilingual psychiatrist. A higher score on the MDSS indicates better perceived social support.

2.2.6. Rosenberg Self-Esteem Scale

Rosenberg Self-Esteem Scale (RSES) is a 10-item self-report instrument measuring an individual's global self-esteem.[19] The validity and reliability of the Chinese version of RSES have been established in Taiwanese populations.[20] A higher score on the RSES indicates a better level of self-esteem.

2.2.7. Alcohol Use Disorder Identification Test-Consumption

Alcohol Use Disorder Identification Test-Consumption (AUDIT-C) contains the first three items of the AUDIT for identifying hazardous drinking.[21,22] The performance of the Chinese version of this short form alcohol-screening instrument has been validated.[23] An AUDIT-C score ≥ 4 had a sensitivity of 0.90 and a specificity of 0.92 for recognizing hazardous alcohol use.[23]

2.2.8. Questionnaire for substance abuse

Participants were asked if they currently smoke regularly and have ever used amphetamine, heroin, cannabis, 3,4-methylenedioxymethamphetamine, ketamine, cocaine, glue, or any other substances in the last month.

2.3. Process and statistical analysis

The online questionnaire, including all the measuring questions, was administered on entry into the study and accessed with participants' individual passwords. All results were automatically transferred to a password-protected database without loss of data. The software Statistics Package for Social Science (SPSS) version 21.0 (IBM, Armonk, New York) was used for statistical analysis.

SH within the previous year was the "outcome" for the analyses. We used the Chi-square or t test to compare between-group differences in the presence of internet addiction and being exposed to others' suicidal thoughts on the internet within the previous year, as well as other potential covariates, e.g., age, gender, the presence of participants' own suicidal ideation and suicide plan, exposure to others' suicidal thoughts in the real world, the presence of depression, the level of perceived social support, and self-esteem, alcohol and substance use, and specific family factors. The variables of SH identified as significant were further examined using univariate logistic regression and hierarchical logistic regression models to investigate confounding and modifying factors. In hierarchical logistic regression analysis, we first examined if the two internet use experiences (internet addiction and exposure to suicidal thoughts on the internet) were related to SH independently (Model I). Then we controlled for gender, specific family factors, exposure to suicidal thoughts in the real world, specific personal factors (depression, alcohol and tobacco use) and concurrent suicidality, and all the other factors identified (Models II—VI).

To analyze the data from those who had harmed themselves, we used the Chi-square or t test to evaluate differences (between groups with vs. no internet addiction and with vs. no internet exposure to suicidal thoughts) in

the number of SH acts, the presence of and suicide intent at the time of SH, and whether internet sites had been consulted about the method of SH.

3. Results

We recruited 3994 first year of high school students from the approached schools. A total of 2479 students provided both their own and their parents' written informed consents and completed the interactive questionnaire (response rate = 62.1%). Their mean age was 15.44 years (range 14—19 years; standard deviation 0.61); the majority were female (n = 1494; 60.3%) and without religious affiliation (n = 1344, 54.2%). The prevalence of SH within the previous year was 10.1% (n = 250). Among the participants, 17.1% had internet addiction (n = 425) and 3.3% had been exposed to suicidal thoughts on the internet (n = 82) within the previous year.

The characteristics of the participants with or without SH are presented in Table 1. Age was not a significant factor, since only students in the first year of high school were recruited. Only one student reported illicit substance use so this factor could not be included in the analysis. Adolescents with SH within the previous year were more likely to be female, to not be currently living with their two biological parents, and to report the presence of family discord. With regards to suicidality, students with SH tended to have suicidal ideation and suicide plans of their own, and to have been exposed to others' suicidal thoughts in the real world and on the internet. In addition, they were more likely to have depression and a lower level of perceived social support and self-esteem, and to be smoking, abusing alcohol, and addicted to the internet.

The results of univariate logistic regression analysis are presented in Table 2. Increased level of perceived social support and self-esteem related to a decreased risk of SH in adolescents. These two factors were identified as potentially protective; we put them at last in the hierarchical logistic regression analysis (Table 3). As shown in Table 3, internet addiction and exposure to suicidal thoughts on the internet were both significantly related to an increased risk of SH, after controlling for gender, specific family factors, exposure to suicidal thoughts in the real life, specific personal factors, and concurrent suicidality (Models I—IV). Adjusting for the level of perceived social support, both variables remained significant risk factors for SH (Model V). However, the association between internet addiction and SH weakened and became nonsignificant after adjusting for the level of self-esteem (Model VI), while internet exposure to suicidal thoughts remained significantly related to an increased risk of SH in adolescents (odds ratio = 1.96; 95% confidence interval: 1.06—3.64).

When further comparing groups among participants with SH to see the characteristics of SH related to the two internet use experiences, we found that students exposed to suicidal thoughts were more likely to engage in more SH acts and have suicide intent at the time of SH (Table 4). Compared with their counterparts, students with internet addiction were significantly more likely to have suicide intent and have consulted internet sites about methods (Table 4).

4. Discussion

This is one of the first community-based studies in adolescents to investigate the association between exposure to confided suicidal ideation from others, and SH. Results revealed that exposure to others' suicidal thoughts increased the likelihood of SH behavior and even non face-to-face exposure on the internet could be a strong risk factor for SH.

The 10.1% prevalence of SH among Taiwanese adolescents found within the previous year is consistent with previous reports of the 12-month prevalence of SH in adolescents (3.2—9.5%).[24] The prevalence rate of internet addiction in our study was 17.1%, which is also consistent with the previously reported rate of 18.8% in southern Taiwan.[11] Of the adolescents surveyed, 3.3% had been exposed to suicidal thoughts on the internet in the past year. Due to the lack of a similar community-based study, we could not compare our results with this result. However, the rate in our study shows that this exposure is not uncommon among adolescent internet users. Given the pervasiveness of internet use in our daily life, the actual number of teenagers exposed to this risk can be substantial. Interactive online activities provide teenagers the opportunities for social networking that are not constrained by traditional physical boundaries or monitored by adults, and so promotes their engagement.[25] Online interactions may provide essential social support for isolated adolescents, but they may also normalize and encourage SH behavior.[26]

A previous study has explored the role of social modeling in the transmission of suicidality through peers. They suggested that the impact of nonfamilial social sources of exposure on an individual's suicidal behavior may be at least as prominent as the impact of familial sources.[7] In our study, we confirmed their results and found even exposure to others' confided suicidal thoughts can increase the risk of SH behavior in adolescents. After controlling for a range of factors, the likelihood of SH in those exposed to suicidal ideation from others in real life, as well from the internet, increased by one-fold compared with those who were not exposed within the past year. The experience of exposure proved to be an important risk factor for adolescents' SH behavior, independent of preexisting vulnerabilities such as depression and their own suicidal ideation. This phenomenon of "social contagion" is an understudied yet consistently found risk factor for nonsuicidal self-injury among adolescents.[27] More research on this is warranted, particularly in what ways this risk may be reduced.

In our study, we found that internet addiction was associated with SH in adolescents after adjustment for the potentially confounding factors, consistent with the finding of a previous study examining the association between internet addiction and self-injurious behavior among adolescents,[28] until the level of self-esteem weakened this association. It has been reported that among adolescents with attention-deficit/hyperactivity disorder, lower self-esteem scores on the RSES were significantly associated with more severe internet addiction symptoms.[29] Whether this association is also true among adolescents with SH behavior, resulting in the weakened

Table 1 Sociodemographic and clinical characteristics of adolescents with self-harm behavior.

	Yes (n = 250)	No (n = 2229)	χ^2 or t
	n (%) or mean (SD)	n (%) or mean (SD)	
Gender			
Male	82 (32.8)	903 (40.5)	5.58*
Female	168 (67.2)	1326 (59.5)	
Age	15.45 (0.58)	15.44 (0.62)	0.19
Living with biological parents			
No	63 (25.2)	344 (15.4)	15.63***
Yes	187 (74.8)	1885 (84.5)	
Family discord			
Yes	43 (17.2)	152 (6.8)	33.42***
No	207 (82.8)	2077 (93.2)	
Family financial difficulties			
Yes	30 (12.0)	190 (8.5)	3.36
No	220 (88.0)	2039 (91.5)	
Suicidal ideation			
No	91 (36.4)	1916 (86.0)	358.1***
Yes	159 (63.6)	313 (14.0)	
Suicide plans			
No	172 (68.8)	2147 (96.3)	282.0***
Yes	78 (31.2)	82 (3.7)	
Exposure to suicidal thoughts (real world)			
No	149 (59.6)	1901 (85.3)	103.6***
Yes	101 (40.4)	328 (14.7)	
Exposure to suicidal thoughts (internet)			
No	222 (88.8)	2175 (97.6)	54.15***
Yes	28 (11.2)	54 (2.4)	
Cigarette smoking			
No	226 (90.4)	2186 (98.1)	50.30***
Yes	24 (9.6)	43 (1.9)	
Hazardous alcohol use (AUDIT-C ≥ 4)			
Yes	47 (18.8)	116 (5.2)	67.64***
No	203 (81.2)	2113 (94.8)	
Depression (PHQ-9 ≥ 15)			
Yes	59 (23.6)	98 (4.4)	139.74***
No	191 (76.4)	2131 (95.6)	
Social support on the MDSS	19.26 (3.45)	20.76 (3.56)	−6.34***
Self-esteem on the RSES	24.71 (5.78)	28.66 (5.37)	−10.94***
Internet addiction			
Yes	77 (30.8)	348 (15.6)	36.50***
No	173 (69.2)	1881 (84.4)	

*$p < 0.05$; ***$p < 0.001$.
AUDIT-C = Alcohol Use Disorder Identification Test-Consumption; MDSS = multi-dimensional support scale; PHQ-9 = Patient Health Questionnaire; RSES = Rosenberg self-esteem scale; SD = standard deviation.

relation between internet addiction and SH, needs further investigation.

Previous studies have identified quite a few bio-psycho-social correlates of SH in adolescents.[30,31] A cross-cultural study of adolescent suicide attempters in Hong Kong and the USA showed that depression, present and lifetime suicidal ideation, hopelessness, poor interpersonal relationships, and exposure to suicide attempters and completers were risk factors for attempted suicide in both cultures.[32] In our study, personal characteristics (i.e., depression, presence of suicidal ideation and suicide plans, self-esteem, smoking and hazardous alcohol use) was associated with adolescent SH. Social support was protective against youth SH behavior, echoing the findings of previous reports.[33,34] The significance of certain family characteristics, such as not living with two biological parents and family discord, disappeared after controlling for personal and other social factors in our sample. This result suggests that for adolescents, perceived social support from different sources may compensate for their original family risks. All these findings remind us again of the importance of a multidisciplinary approach when we are dealing with a teenager engaging in SH.

When extended to an examination of the characteristics of students exposed to confided suicidal thoughts on the internet within the SH subsample, our analysis found that

Table 2 Factors associated with self-harm in adolescents: univariate logistic regression analysis.

	Wald	OR	95% CI
Internet addiction	37.76***	2.41	1.80−3.22
Exposure to suicidal thoughts (on the internet)	44.63***	5.08	3.15−8.18
Female gender	5.54*	1.40	1.06−1.84
Not living with biological parents	15.24***	1.85	1.36−2.51
Family discord	30.97***	2.84	1.97−4.10
Exposure to suicidal thoughts (in the real world)	92.74***	3.93	2.97−5.19
Smoking	40.73***	5.40	3.22−9.06
Hazardous alcohol use	58.68***	4.22	2.92−6.10
Depression	110.40***	6.72	4.71−9.58
Suicidal ideation	267.50***	10.70	8.05−14.21
Suicide plans	195.63***	11.87	8.40−16.79
Social support	38.65***	0.89	0.86−0.92
Self-esteem	106.31***	0.88	0.85−0.90

CI = confidence interval; OR = odds ratio.
*$p < 0.05$; ***$p < 0.001$.

Table 3 Factors associated with self-harm in adolescents: hierarchical logistic regression analysis.

	Model I		Model II		Model III		Model IV		Model V		Model VI	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Internet addiction	2.20***	1.64–2.97	2.04***	1.49–2.79	1.59**	1.41–2.22	1.50*	1.06–2.13	1.46*	1.03–2.07	1.38	0.97–1.96
Exposure to suicidal thoughts (on the internet)	4.36***	2.68–7.10	2.82***	1.67–4.75	1.98*	1.12–3.49	2.06*	1.11–3.82	2.00*	1.08–3.72	1.96*	1.06–3.64
Female gender			1.29	0.96–1.73	1.32	0.97–1.79	1.07	0.78–1.49	1.09	0.79–1.51	1.04	0.75–1.45
Not living with biological parents			1.49*	1.07–2.08	1.38	0.97–1.96	1.31	0.90–1.91	1.30	0.89–1.89	1.33	0.91–1.93
Family discord			2.26***	1.51–3.37	1.66*	1.08–2.56	1.36	0.85–2.16	1.31	0.82–2.08	1.25	0.78–1.99
Exposure to suicidal thoughts (in the real world)			3.33***	2.48–4.47	3.05***	2.25–4.15	1.99***	1.43–2.77	2.01***	1.44–2.80	2.01***	1.44–2.81
Smoking					2.82**	1.51–5.28	2.45*	1.24–4.85	2.47**	1.26–4.85	2.43*	1.23–4.82
Hazardous alcohol use					2.12**	1.37–3.30	1.53	0.95–2.47	1.53	0.95–2.48	1.61	0.99–2.60
Depression					3.86***	2.59–5.77	2.07**	1.33–3.21	1.97**	1.27–3.06	1.68*	1.07–2.63
Suicidal ideation							5.27***	3.72–7.47	5.00***	3.52–7.10	4.45***	3.11–6.35
Suicide plans							2.13**	1.39–3.28	2.12**	1.38–3.26	2.04**	1.32–3.15
Social support									0.95**	0.91–0.99	0.96*	0.92–1.00
Self-esteem											0.95**	0.93–0.98

CI = confidence interval; OR = odds ratio.
*p < 0.05; **p < 0.01; ***p < 0.001.

Table 4 Characteristics of self-harm acts in students with internet addiction or internet exposure to suicidal thoughts in a subsample of the SH group (n = 250).

	Internet addiction		χ^2 or t	Internet exposure to suicidal thoughts		χ^2 or t
	Yes (n = 77)	No (n = 173)		Yes (n = 33)	No (n = 217)	
	n (%) or mean (SD)	n (%) or mean (SD)		n (%) or mean (SD)	n (%) or mean (SD)	
Number of self-harm acts	6.01 (3.85)	5.21 (3.71)	0.22	7.15 (3.69)	5.20 (3.72)	2.81**
Suicide intent						
Yes	34 (44.2)	49 (28.3)	6.02*	18 (54.5)	65 (30)	7.81**
No	43 (55.8)	124 (71.7)		15 (45.5)	152 (70)	
Research suicide methods on the internet						
Yes	4 (5.2)	1 (0.6)	5.80*	2 (6.1)	3 (1.4)	3.20
No	73 (94.8)	172 (99.4)		31 (93.9)	214 (98.6)	

*p < 0.05; **p < 0.01.
SD = standard deviation; SH = self-harm.

they were more prone to SH acts and intent to die. As this was a cross-sectional survey, we were not able to determine the causal relationship between the exposure, the number of SH acts, and their suicide intent. Adolescents may be developing or reinforcing their suicidal ideation by disclosure of others' suicidal thoughts, and enacting their own SH behavior. Moreover, youths may utilize the internet in ways that differ from the general population with respect to suicide. A previous study measured Google internet search engine activity for suicide-related terms and correlated to available suicide and intentional self-injury data. They found that whereas internet search

activity was negatively correlated to the suicide rate in the general population, it was positively correlated to both intentional self-injury and completed suicides among youths.[35] In our study, adolescents with internet addiction did tend to consult the internet site about the methods they used to SH. The availability of this tool on the one hand may provide a person's access to information, however, it may also facilitate the implementation of suicide by vulnerable youths.[36] Special attention should be paid to the ways young, frequent internet users use the internet. The application of media guidelines for suicide prevention is demanded for websites, as are accessible self-help sites for suicidal persons targeted to youthful users.[36]

Some limitations of our study should be considered. The evidence provided by a cross-sectional design study is insufficient to draw any causal inference. Our measurement was based on self-report, so there might be a report bias. Information on illicit substance abuse only relied on one closed-ended question instead of a validated questionnaire. As a result, this variable could not be included in the analysis to be adjusted for. Despite the limitations, our study was the first to examine the association between exposure to confided suicidal ideation and SH at a community level; we proved internet addiction and internet exposure of suicidal thought linked to SH in adolescents; and as discussed above, our findings are consistent with several previous studies in the field.

5. Conclusion

Online experiences are associated with SH in adolescents. Preventive strategies may include education to increase social awareness, identification of those exposed to the risk, and provision of prompt help.

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