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Authors

Lidón-Moyano, Cristina
Wiebe, Deborah
Gruenewald, Paul
et al.

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Associations between self-harm and chronic disease among adolescents: Cohort study using statewide emergency department data

Cristina Lidón-Moyano, Ph.D.,
Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Deborah Wiebe, Ph.D.,
Department of Psychology; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Paul Gruenewald, Ph.D.,
Prevention Research Center, Pacific Institute for Research and Evaluation; Oakland, CA 94612 USA.

Magdalena Cerda, Dr.PH.,
Violence Prevention Research Program, University of California, Davis; Sacramento, CA 95817.

Paul Brown, Ph.D., and
Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Sidra Goldman-Mellor, Ph.D.[*]
Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Abstract

Introduction.—We sought to understand the association between youthful self-harm and subsequent chronic disease-related healthcare utilization and whether self-harm reflects unique vulnerability in comparison with severe psychiatric disorders.

Methods.—We used a retrospective matched cohort design with statewide, all-payer, individually linked emergency department (ED) data from California, USA. Risk of future ED visits for common chronic conditions in adolescence (headaches, asthma, epilepsy, diabetes, and gastrointestinal disorders, assessed using *ICD-9* diagnoses) were compared between three adolescent study groups presenting to an ED in 2010: self-harm patients (n=5,484), patients with

[*]Corresponding author: Sidra Goldman-Mellor, Ph.D., Department of Public Health, School of Social Sciences, Humanities, and Arts, University of California, Merced; Merced, CA 95343, USA, (209) 228-2498, sgoldman-mellor@ucmerced.edu.

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psychiatric complaints but no self-harm (n=14,235), and patients with other complaints (n=16,452). Cohort follow-up ended on Sept. 30, 2015. Analyses were adjusted for patients' prior histories of ED utilization for chronic conditions as well as patient- and area-level sociodemographic characteristics.

Results.—Risk of subsequent ED visits was higher among self-harm patients compared to non-psychiatric control patients for subsequent epilepsy- (aRR=1.77, 95% CI [1.42, 2.21]). Risk of subsequent ED visits was higher among psychiatric patients compared to non-psychiatric control patients for subsequent headache- (aRR=1.31, 95% CI [1.21, 1.42]), and epilepsy-related problems (aRR=1.85, 95% CI [1.55, 2.21]). Self-harm patients were at higher risk than psychiatric patients for subsequent gastrointestinal disorder (aRR=1.76, 95% CI [1.03, 3.01]).

Conclusions.—Findings suggest that self-harm behavior and psychiatric disorders are associated with increased ED utilization for subsequent chronic disease-related ED utilization. Chronic disease among adolescent psychiatric patients should be attended to, potentially involving new models of clinical follow-up care.

Keywords

Self-injurious behavior; mental disorders; chronic disease; adolescent; emergency service

Nonfatal self-harm among adolescents in the U.S. is a critical and worsening public health problem. Emergency department visits for self-harm injury among youths aged 10–19 years, for example, rose 54% between 2005 and 2015 (Centers for Disease Control and Prevention, 2005). This troubling trend contrasts sharply with other U.S. adolescent health indicators, such as alcohol and illicit drug use, which have improved during the 21st century (U.S. Department of Health and Human Services, 2014). Concerns about the increase in self-harm are amplified by a growing body of research reporting that self-harming youths face substantially elevated lifetime risk for chronic health problems. For example, young people who attempt suicide are more likely than non-attempting peers to subsequently self-report gastrointestinal disorders, migraine, asthma, and epilepsy (Hesdorffer et al., 2012); to have poorly managed diabetes (Goldston et al., 1997); and to die prematurely of cardiovascular disease and cancer (Ballard et al., 2014; Goldman-Mellor et al., 2014; Jokinen, Mattsson, Lagergren, Lagergren, & Ljung, 2015; Shah, Veledar, Hong, Bremner, & Vaccarino, 2011; Shanahan, Schorpp, Volpe, Linthicum, & Freeman, 2016).

Such work suggests that the growing population of youths engaging in suicidal or self-harm behavior may be in jeopardy of excess impairment, healthcare needs, and health-related economic burden, perhaps beginning as early as adolescence and continuing into their adult lives. In one cohort study from New Zealand, youths who attempted suicide were more likely than non-attempting peers to have high levels of inflammation and cardiovascular disease risk at age 38, but disease-related impairment and healthcare utilization in the intervening years were not measured (Goldman-Mellor et al., 2014). In a prospective study of students from Baltimore, M.D., a history of suicide attempt was associated with significantly greater adulthood risk of self-reported gastrointestinal disorders and migraine, as well as self-reported recent emergency department utilization (though not primary care or hospitalization) (Ballard et al., 2014). However, no patient medical records were collected to

confirm these diagnoses, and it was unclear whether study participants' ED utilization was for chronic health conditions versus other kinds of complaints. Very little research, therefore, has examined objective indicators of chronic disease-related impairment or healthcare utilization among these vulnerable adolescents.

An important question is thus to understand chronic disease burden and related healthcare utilization in the years immediately following a youthful self-harm event, when adolescents are learning to independently manage their health and patterns of self-care become engrained (Phillips, Fenton, Cohen, Javalkar, & Ferris, 2015). Emergency department utilization may be a particularly important indicator to study when investigating this relationship. Young people in the U.S. obtain an increasing proportion of their care from EDs (Rasooly, Mullins, Alpern, & Pines, 2014), and excess ED utilization can reflect inadequate outpatient care or lack of other health care resources (Dolan, Fein, & Committee on Pediatric Emergency Medicine, 2011). ED visits, along with inpatient hospitalizations, are also the costliest forms of healthcare (Kashihara & Carper, 2012). However, hospital settings also offer a window of opportunity: clinicians and social services personnel can refer vulnerable young patients and their families to outpatient care resources, and EDs often serve as an intervention site (Asarnow, Berk, Hughes, & Anderson, 2015; Merz, Baptista, & Haller, 2015).

A second important question in the literature linking youth self-harm behavior to subsequent chronic disease outcomes is whether self-harm genuinely reflects unique vulnerability or is simply a proxy measure for more severe psychiatric disorders. Some work suggests that self-harm behavior is distinct from ostensibly similar psychiatric problems such as major depression, citing evidence that self-harm behavior tends to emerge from a combination of internalizing (e.g., depression) and impulsive-aggressive externalizing (e.g., conduct disorder) traits (Franklin et al., 2016; Orri et al., 2018). Internalizing and externalizing traits may affect individuals' ability to manage chronic conditions through pathways involving impaired executive functioning, increased risk of substance abuse, poor diet, lack of sleep, and poor adherence to medical treatments, thereby worsening their chronic disease prognosis (Jokinen et al., 2015; Keilp et al., 2013; Marzuk, Hartwell, Leon, & Portera, 2005). For instance, self-harm is associated with smoking, increasing the risk of either developing or exacerbating asthma symptoms, even after adjusting for mental disorders (Clarke, Goodwin, Messias, & Eaton, 2008). Previous work also shows that suicidal ideation and suicide attempts predict serious noncompliance with medical treatment among adolescent patients with type 1 diabetes, even controlling for presence of psychiatric disorders (Goldston et al., 1997). On the other hand, severe psychiatric disorders themselves confer risk for chronic disease (Ford, Trestman, Steinberg, Tennen, & Allen, 2004; Roy-Byrne et al., 2008), and some studies find that youth self-harm behavior does not predict subsequent outcomes after controlling for other psychiatric and psychosocial factors (Copeland, Goldston, & Costello, 2017).

In the current study, we hypothesized that adolescents treated in EDs for self-harm would have worse chronic condition outcomes when compared to patients who were treated for other reasons. We also hypothesized that adolescents treated in EDs for self-harm would have worse chronic condition outcomes when compared to patients who were treated for

other urgent and serious psychiatric problems, but who did not present with deliberate self-harm. To test these hypotheses, we used longitudinal patient data from California to examine subsequent emergency department visits for chronic conditions among three study groups: (1) patients presenting to the ED with self-harm, (2) patients presenting with psychiatric complaints but no current self-harm, (3) and patients presenting for non-psychiatric complaints. We focused on chronic conditions that are common in youth as well as observable in hospital data: headaches, asthma, epilepsy, diabetes, and gastrointestinal disorders. Additionally, to separate out the effect of self-harm and psychiatric patients' potential pre-existing physical health problems, we controlled for their prior histories of ED utilization (both overall and for the specific chronic conditions of interest).

METHODS

Data

A retrospective matched cohort design was used to compare subsequent ED visits for chronic conditions among adolescent patients presenting with self-harm, those presenting with psychiatric complaints but no current self-harm, and those presenting for other complaints. This study used nonpublic versions of individual-level ED data from 2006 through 2015 provided by the California Office of Statewide Health Planning and Development (OSHPD). All data were screened by OSHPD's automated data entry and reporting software program (MIRCal), which returns data fields with error rates of ≥0.1% to the hospitals for correction (Office of Statewide Healthcare Planning and Development, 2017). Patients with missing age and/or sex were excluded. This study was approved by the University of California, Merced Institutional Review Board.

The study dataset consisted of ED records for all adolescent patients aged 10 to 19 years who had a unique identifier (encrypted social security number) and a California residential zip code in 2010 (Goldman-Mellor et al., 2018). Unique identifiers were used to link all visits made by a specific patient over time, to any California hospital facility; links were made both for several years prior (2006–2009) and subsequent (2010–2015) to the patient's index 2010 visit (defined below).

Definition of the study groups

We defined the three study groups using each patient's primary *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) (Medicode, 1996) External Cause of Injury code (E-code) or Clinical Classification Software (CCS) code at his/her index visit in 2010. CCS codes aggregate ICD-9-CM diagnoses into a smaller number of discrete, clinically meaningful categories (Elixhauser, Steiner, & Palmer, 2014). The first group was self-harm patients, who presented to an ED in 2010 with a primary ICD-9-CM code of E950.0–959 (Crosby, Ortega, & Melanson, 2011). The second group was a matched set of psychiatric patients, who presented in 2010 with a psychological complaint (CCS codes 650–659, 662, 663, or 670, which together aggregate ICD-9-CM codes 290–319) but not for self-harm. The third group was a matched set of non-psychiatric control patients, comprising adolescents who presented for any other condition in 2010. Psychiatric patients and non-psychiatric control patients were randomly selected and matched 3:1 to self-harm

patients on age (within 1 year), sex and month of the index visit, to control for confounding by key demographic factors and seasonality (Canner, Giuliano, Selvarajah, Hammond, & Schneider, 2016). The index visit was defined for self-harm and psychiatric patients as their first self-harm or psychiatric visit in 2010, respectively, and for non-psychiatric control patients as their first visit for any condition in 2010. After excluding those patients who died at index visit (n=71), a total of 480 632 unique adolescent patients were available for the analyses presented here. Most (74%) adolescents made a subsequent visit during follow-up. For 1.5% of patients, gender or birthdate reported at the subsequent visit were inconsistent with those at index visit; visual inspection suggested that these inconsistencies were largely the result of data entry error. The final sample included all self-harm patients (n=5484) as well as matched samples of 16 452 non-psychiatric control patients and 14 235 psychiatric patients.

Cohort follow-up began on the date following each patient's index visit and ended (i.e., all patients were censored) on Sept. 30, 2015, to avoid diagnosis misclassification problems related to the mandatory transition from *ICD-9-CM* to *ICD-10-CM* coding on Oct. 1, 2015 (Injury Surveillance Workgroup 9 Safe States Alliance, 2016).

Outcome measures

Chronic disease ED visits were defined based on the CCS code in the primary position: *Headache*, including both headache and migraine (CCS code 84); *asthma* (128); *epilepsy* (83); *diabetes*, including both type 1 and type 2 diabetes (49–50); and *gastrointestinal disorder*, including codes for both gastroduodenal ulcer (139) and regional enteritis and ulcerative colitis (144). The constituent ICD-9-CM codes for each outcome's CCS codes are shown in Table S1.

Covariates

Characteristics at index visit.—Patient-level characteristics assessed at index visit included race/ethnicity (collapsed into White, Black, Hispanic, Asian/Pacific Islander, or other), and insurance type (collapsed into private, Medicaid, self-pay, or other). In addition, several area-level characteristics were also assessed at the index visit. These were measured for the patients' residential zip codes, and included the percent of families below poverty level, the unemployment rate, and the median household income, based on 2010 estimates supplied by GeoLytics (Geolytics Estimates Premium, 2011). Zipcode urbanicity was also included, defined using the U.S. Department of Agriculture's Rural-Urban Commuting Areas 2010 geographic taxonomy, Version 3.10 (collapsed into metropolitan, micropolitan, and small town/rural categories) (Economic Research Service USDA. Rural-Urban Commuting Area Codes, version 3.10, 2014).

Patient visit histories.—For each patient, we constructed a visit history variable indicating the total number of ED visits made in the 4 years prior to 2010 (2006–2009). In multivariate models, patients who made >20 visits were reclassified as having made 20 visits to; descriptive analyses present true group means. We then used ICD-9-CM E-codes and CCS codes to construct patient visit histories for specific clinical conditions. Visit histories were constructed for any psychiatric complaint visit (CCS codes 650–659, 662, 663, or

670); any self-harm visit (*ICD-9-CM* codes E950.0-E959); any substance use visit (CCS codes 660 or 661); any headache visit (CCS code 84); any asthma visit (CCS code 128); any epilepsy visit (CCS code 83); and any diabetes visit (CCS code 49–50). No history variable for gastrointestinal disorders was included, as prior visits for this condition were extremely rare.

Statistical Analyses

For each outcome, we used chi-square or ANOVA tests to study baseline group differences. We then estimated risk ratios (RR) and their 95% confidence intervals (95% CI) using a negative binomial model with log link and robust standard errors (Zou, 2004). Follow-up time in days for each patient was included as an offset, to account for patients' varying index visit dates.

We first ran each model using non-psychiatric control patients as the reference group. We then reran each model using psychiatric patients as the reference group, to obtain a direct comparison between self-harm and psychiatric patients. We implemented both unadjusted models and models adjusted for patient sociodemographic characteristics at index visit and patient visit histories. The adjusted model for each disease outcome controlled for patients' past visit histories of that specific disease (e.g., the model for subsequent asthma controlled for prior history of an asthma visit).

We also performed a sensitivity analysis in which we reran each model excluding patients whose index self-inflicted injury method was cutting/piercing, as these events more often involve non-suicidal self-injury (Brausch, Williams, & Cox, 2016). Stata 15 (College Station, Texas) was used for all analyses.

RESULTS

Patient characteristics assessed at index visit and during 2006–2009 for all study patients, and separately for self-harm, psychiatric and non-psychiatric control patients, are shown in Table 1. On average, self-harm patients had greater ED visit histories than non-psychiatric control patients for psychiatric complaints, self-harm, substance abuse, headache, asthma, epilepsy, and diabetes. Self-harm patients also had more substantial visit histories than psychiatric patients for psychiatric complaints, self-harm, substance abuse, headache, asthma, epilepsy, and diabetes. Psychiatric patients had greater ED visit histories than non-psychiatric control patients for psychiatric complaints, self-harm, substance abuse, headache, asthma, and epilepsy.

Cumulative incidence of chronic disease-related ED visits varied substantially by outcome. Headache visits were the most common; 9.1% of the entire final sample (36 171 participants) made a visit for headache during follow-up. Asthma visits were the second-most common, and were made by 4.0% of the cohort. Epilepsy-, diabetes-, and gastrointestinal disorder-related visits were considerably rarer, with cumulative incidences of 2.2%, 0.7%, and 0.3%, respectively. The percentages of each study group with each outcome in each year from 2010 through 2015 are shown in Figure 1.

Unadjusted and adjusted risk ratios for subsequent visits for headache, asthma, epilepsy, diabetes, and gastrointestinal disorders, using non-psychiatric control patients as the reference group, are shown in Table S2 and Table 2, respectively. As expected, patient histories of ED utilization – both overall and for each specific chronic condition – were highly associated with increased risk of subsequent chronic condition visits. However, after controlling for these and the other covariates, the risk of a subsequent epilepsy visit was 77% higher among self-harm patients compared to non-psychiatric control patients. Self-harm patients were not, however, at higher risk than non-psychiatric control patients for subsequent headache, asthma, diabetes or gastrointestinal visits in adjusted models.

Risk of a subsequent headache visit was 31% higher, and risk of a subsequent epilepsy visit was 85% higher, among psychiatric patients compared to non-psychiatric control patients. Risk of the other outcomes did not differ between these groups.

We then re-estimated the models for self-harm patients using psychiatric patients as the reference group. These models indicated that self-harm patients were at lower risk than psychiatric patients for subsequent headache visits (aRR=0.74, 95% CI [0.67, 0.83]) and at higher risk for subsequent gastrointestinal disorder (aRR=1.76, 95% CI [1.03, 3.01]) visits. Self-harm patients and psychiatric patients were equally likely, however, to have subsequent visits for asthma (aRR=0.97, 95% CI [0.82, 1.14]), epilepsy (aRR=0.96, 95% CI [0.79, 1.17]), and diabetes (aRR=1.27, 95% CI [0.87, 1.85]).

Finally, we re-estimated all self-harm models, this time excluding cutting/piercing patients from the self-harm group. When using non-psychiatric control patients as the reference group, the association between self-harm and subsequent gastrointestinal disorder (aRR=1.80, 95% CI [1.05, 3.08]) and headache (aRR=0.74, 95% CI [0.67, 0.83]) visits became significant, while the association between self-harm and subsequent epilepsy visits became non-significant (aRR=0.96, 95% CI [0.79, 1.83]). When using psychiatric patients as the reference group, the association between self-harm and subsequent epilepsy (aRR=1.77, 95% CI [1.42, 2.21]) visits became significant, while the association between self-harm and subsequent gastrointestinal disorder (aRR=1.53, 95% CI [0.91, 2.58]) and headache (aRR=0.98, 95% CI [0.87, 1.10]) visits became non-significant.

DISCUSSION

Results from our population-based study partially confirmed our first hypothesis, as, overall, self-harm patients presented to the emergency department more frequently than non-psychiatric control patients for subsequent chronic conditions. However, this excess risk remained only for specific chronic diseases, such as epilepsy, after controlling for covariates. Psychiatric patients also visited the ED more frequently than non-psychiatric control patients for headache and epilepsy, after controlling for covariates. Our second hypothesis was also partially supported, as self-harm patients were at higher risk than psychiatric patients for subsequent gastrointestinal disorder problems. However, self-harm patients experienced no excess risk for many of the chronic disease outcomes we studied when compared to either non-psychiatric or psychiatric control patients and controlling for important covariates.

Our results are in line to a certain extent with previous studies supporting an association between self-harm behavior and adverse chronic disease-related outcomes, including morbidity and mortality due to chronic disease (Goldman-Mellor et al., 2014; Jokinen et al., 2015; Shah et al., 2011; Shanahan et al., 2016). Prior research has shown, for example, that suicidal behavior increases the risk of clinical measures of both incident diagnosis and poor disease prognosis for epilepsy (Hesdorffer et al., 2012; Hesdorffer, Hauser, Olafsson, Ludvigsson, & Kjartansson, 2006). The higher risk of subsequent gastrointestinal disorders among self-harm patients we observed after excluding cutting/piercing patients from the self-harm group is also in line with previous literature showing young people who attempt suicide are more likely than non-attempting peers to subsequently self-report gastrointestinal disorders, migraine asthma, and epilepsy (Hesdorffer et al., 2012). Similarly, previous works also suggest the history of suicide attempt is associated with significantly greater adulthood risk of gastrointestinal disorders and migraine (Ballard et al., 2014). These previous reports focused on *self-reported* chronic disease problems, and often measured outcomes in midlife (Goldman-Mellor et al., 2014; Goldston et al., 1997; Ballard et al., 2014, Hesdorffer et al., 2012). Our study contributes to this literature by analyzing actual ED utilization for chronic disease – an objective indicator not only of disease severity but also of costly service utilization – in late adolescence and early adulthood. Moreover, to account for the effect of pre-existing physical health problems, we controlled for prior histories of ED utilization both overall and for the specific chronic conditions of interest, which prior studies could not always do. Our results suggest that associations between self-harm and subsequent chronic disease may not be as strong as previous work suggested.

Prior research showing differences in health outcomes between young suicide attempters and controls suggested the possibility that self-harm may not have an independent causal effect, but may be more properly understood as a proxy for severe psychiatric disorders or other vulnerabilities more common among self-harming youths (Copeland et al., 2017; Goldman-Mellor et al., 2014; Shah et al., 2011). Our observations that (in covariate-adjusted models) self-harm patients were at higher risk than psychiatric patients only in the case of gastrointestinal disorder, yet had greater histories of ED visits for psychiatric reasons than the psychiatric patient group, lends support to this interpretation. However, our analysis hinged on assessing an extreme group – individuals presenting to the emergency department – and it is possible that different results would be observed with a different type of sample. Individuals who seek ED or other medical care after a self-harm event or psychiatric crisis event are more likely than others, for example, to have severe psychological symptoms, a family history of self-harm, and low household socioeconomic status (Chaput, & Lebel, 2007; Michelmore & Hindley, 2012). Moreover, it is also possible that a significant portion of the adolescent self-harm events observed in our study were impulsive rather than the result of ongoing depression or other severe psychiatric disorders. These more impulsive acts might arise from time-limited crises that would not be expected to have long-term health outcomes. Nonetheless, according to our results, self-harm behavior may be best conceptualized as a proxy measure for more severe psychiatric disorders rather than reflecting unique vulnerability.

Why self-harm and mental health patients are at higher risk for ED utilization related to some chronic diseases, but not others, remains unclear. For some conditions, like diabetes,

our analysis may have been underpowered to detect significant group differences (e.g., power analyses conducted in Stata suggested that our analysis had 80% power to detect a risk ratio of 1.64 when comparing self-harm to psychiatric patients for the diabetes outcome; the actual [non-significant] RR we calculated for that outcome was 1.27). It is also possible that the traits characterizing self-harm behavior (e.g. externalizing symptoms, poor executive function, etc.) might interfere to a greater extent with the disease management of some disorders versus others. For example, externalizing symptoms appear to affect disease management of pediatric diabetes (King et al., 2012), but not asthma (Bender, Milgrom, Rand, & Ackerson, 1998). It is also possible that the physiological effects of psychiatric medications have effects on symptomatology of some chronic diseases but not others. Lastly, health service usage patterns can differ significantly among adolescents and for specific diseases (Chaput et al., 2007; Michelmore & Hindley, 2012; Goldman-Mellor et al., 2018). Although our analysis controlled for race, health insurance, area-level economic characteristics, and urbanicity, as well as a measure of patients' ED utilization, we might not have been able to fully account for such differences. Moreover, our results changed somewhat after excluding cutting/piercing patients from the self-harm group, suggesting that there is substantive variation among adolescent self-harm patients with respect to their prognosis. Further research is needed to understand why self-harm and psychiatric patients are at higher risk for ED utilization related to some chronic diseases, but not others, and how subtypes of self-harm behavior confer differential chronic disease risk.

This study had several limitations. First, while a significant strength of the study was its capacity to observe patients' visits to any ED in California, visits occurring out-of-state were unobservable. It was unlikely, however, that this led to substantially biased results, because overall out-migration from California was low during this time period (0.2%) (Center for Continuing Study of the California Economy, 2016). Second, we lacked longitudinal data on patient visits without a unique identifier and, although visits with and without identifiers were relatively similar, our results may not be generalizable to all California adolescents presenting to the ED. Further limitations include potential misclassification of the chronic disease outcomes, for instance, benign neurologic conditions are sometimes mislabeled as seizure (Moeller, Kurniawan, Gubitz, & Ross, 2008), and lack of measures of certain confounders such as childhood adversity (Dube et al., 2001). Finally, as described above, our data consist only of individuals visiting the ED, and therefore our results may not be generalizable to youths who have psychiatric or self-harm problems but do not seek ED care. ED utilization is driven by many factors besides patient disease status, including access to other health care options, clinical referral patterns, convenience, and perceptions of care quality (Kubicek et al., 2012). Further research in other samples would be helpful to clarify this issue.

In conclusion, findings from our large, population-based study of adolescent ED patients suggest that self-harm behaviors and serious psychiatric disorders are associated with increased emergency department utilization for subsequent chronic disease-related visits, especially for epilepsy. These utilization patterns suggest poor management of disease and excess healthcare-related economic burden in a critical period for adolescence, when teens start to self-manage their conditions and entrain lifelong health behaviors (Sawyer & Aroni, 2005). Currently, significant resources are already devoted to intervening with self-harming

adolescents and those with psychiatric disorders. Our results indicate that chronic disease outcomes should also be given attention in this patient population, potentially involving new models of clinical follow-up care and intervention. Future research should investigate the causal pathways underlying this association, to improve patient prognosis for both mentally ill and adolescents suffering chronic diseases.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations list:

OSHPD	California Office of Statewide Health Planning and Development
E-code	External Cause of Injury code
CCS	Clinical Classification Software
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification

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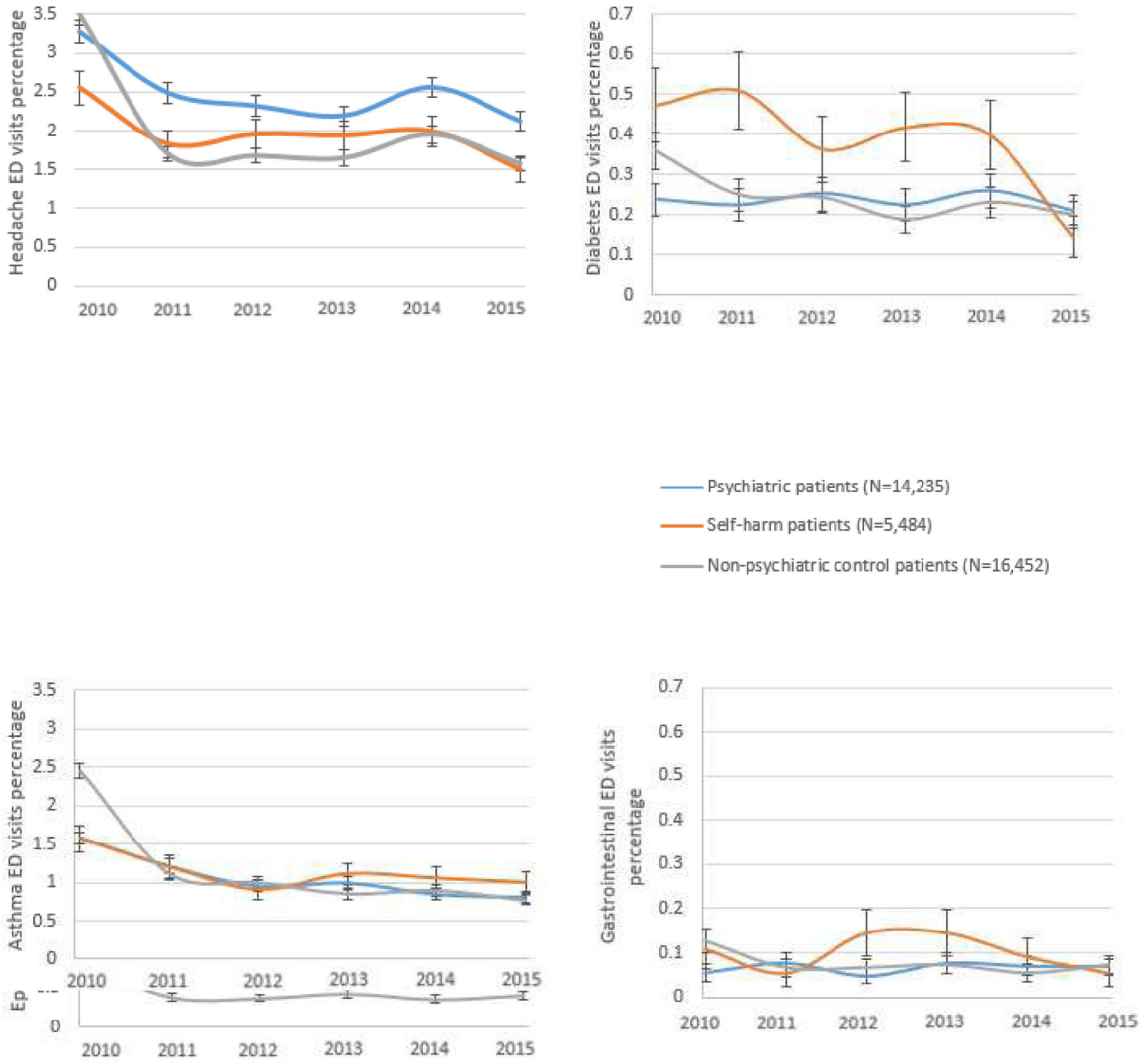

Figure 1.

Annual percentage of each study group who had any chronic disease ED visit among 36,171 patients in California, 2010 through Sept. 30, 2015. Bars indicate standard errors.

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Table 1.

Characteristics assessed at index visit, during 2006–2009 and during 2010 through Sept. 30, 2015, according to patient status, among 36,171 adolescents receiving emergency department care in California during 2010.

	All patients (N=36 171)		Psychiatric patients (N=14 235)		Self-harm patients (N=5484)		Non-psychiatric control patients (N=16 452)		X/F*,	P-value
	n / mean	% / SD	n / mean	% / SD	n / mean	% / SD	n / mean	% / SD		
Patient characteristics at index visit:										
Female sex	22 431	62.0%	8383	58.9%	3512	64.0%	10 536	64.0%	97.2,	<0.001[a]
Age	16.5	2.2	16.4	2.3	16.6	2.0	16.5	2.2	20.7,	<0.001[b]
Race/ethnicity										
White	13 492	37.3%	5443	38.2%	2386	43.5%	5663	34.4%	169.3,	<0.001[a]
Black	4387	12.1%	1694	11.9%	601	11.0%	2092	12.7%		
Hispanic	14 249	39.4%	5508	38.7%	1886	34.3%	6855	41.7%		
Asian/Pacific Islander	1394	3.9%	538	3.8%	197	3.6%	659	4.0%		
Other	2649	7.3%	1052	7.4%	414	7.6%	1183	7.2%		
Insurance type										
Private	15 343	42.4%	6151	43.2%	2328	42.5%	6864	41.7%	65.5,	<0.001[a]
Medicaid	14 790	40.9%	5692	40.0%	2378	43.4%	6720	40.8%		
Self-pay	4851	13.4%	1987	14.0%	584	10.6%	2280	13.9%		
Other	1184	3.3%	404	2.8%	194	3.5%	586	3.6%		
Urbanicity										
Metropolitan	33 364	92.3%	13 273	93.2%	4977	90.8%	15 114	91.9%	40.6,	<0.001[a]
Micropolitan	1987	5.5%	684	4.8%	370	6.8%	933	5.7%		
Small town	810	2.2%	278	2.0%	133	2.4%	399	2.4%		
Poverty level	11.2	7.3	11.0	7.4	10.9	7.2	11.5	7.3	22.1,	<0.001[b]
Unemployment rate	13.9	9.5	13.5	9.4	13.5	9.3	14.3	9.7	32.8,	<0.001[b]
Median household income in $	48 920.1	17927.3	49 746.7	18 604.1	49 235.9	18 056.9	48 101.8	17 240.8	32.8,	<0.001[b]
Patient 2006–2009 history of:										

	All patients (N=36 171)		Psychiatric patients (N=14 235)		Self-harm patients (N=5484)		Non-psychiatric control patients (N=16 452)		X/F*,	P-value
	n / mean	% / SD	n / mean	% / SD	n / mean	% / SD	n / mean	% / SD		
Any psychiatric visit	2924	8.1%	1761	12.4%	763	13.9%	400	2.4%	1300,	<0.001[a]
Any self-harm visit	936	2.6%	347	2.4%	462	8.4%	127	0.8%	957.6,	<0.001[a]
Any headache visit	1129	3.1%	466	3.3%	198	3.6%	465	2.8%	10.2,	0.006[a]
Any asthma visit	903	2.5%	361	2.5%	142	2.6%	400	2.4%	0.6,	0.751[a]
Any epilepsy visit	340	0.9%	156	1.1%	67	1.2%	117	0.7%	17.6,	<0.001[a]
Any diabetes visit	93	0.3%	30	0.2%	22	0.4%	41	0.2%	5.7,	0.059[a]
Any substance abuse visit	800	2.2%	368	2.6%	225	4.1%	207	1.3%	169.0,	<0.001[a]
Total visits	1.7	3.1	1.8	3.3	2.2	4.2	1.4	2.4	151.3,	<0.001[b]

*X/F refers to the chi-squared (X) or Anova (F) test statistic

a. Chi-squared test

b. Anova test

Table 2.

Adjusted risk ratios and 95% confidence intervals for subsequent chronic disease visits through Sept. 30, 2015, according to characteristics assessed at index 2010 visit and during 2006–2009, among psychiatric, self-harm and non-psychiatric control patients in California.

	Headache	Asthma	Epilepsy	Diabetes	Gastrointestinal disorder[a]
Study groups:					
Non-psychiatric control patients	Ref.	Ref.	Ref.	Ref.	Ref.
Self-harm patients	0.98 (0.87, 1.11)	1.03 (0.87, 1.22)	**1.76 (1.41, 2.21)** ***	1.33 (0.91, 1.95)	1.46 (0.87,2.46)
Psychiatric patients	**1.35 (1.24, 1.46)** ***	1.03 (0.92, 1.17)	**1.84 (1.54, 2.20)** ***	1.05 (0.77, 1.44)	0.84 (0.53,1.32)
Patient 2006–2009 history of:					
Any headache visit	**1.89 (1.64, 2.18)** ***	-	-	-	-
Any asthma visit	-	**7.34 (6.28, 8.59)** ***	-	-	-
Any epilepsy visit	-	-	**19.50 (15.51, 24.51)** ***	-	-
Any diabetes visits	-	-	-	**108.19 (73.56, 159.13)** ***	-
Any psychiatric visit	0.97 (0.85, 1.10)	1.12 (0.93, 1.34)	**1.39 (1.11, 1.74)** **	**1.59 (1.03, 2.44)** *	1.24 (0.65,2.38)
Any self-harm visit	0.83 (0.67, 1.02)	1.09 (0.82, 1.45)	**1.60 (1.16, 2.21)** **	1.01 (0.49, 2.07)	0.29 (0.07, 1.28)
Any substance abuse visit	0.89 (0.70, 1.11)	0.95 (0.68, 1.31)	1.33 (0.92, 1.93)	1.12 (0.56, 2.24)	0.28 (0.04, 2.04)
Total visits	**1.10 (1.09, 1.11)** ***	**1.08 (1.07, 1.10)** ***	**1.05 (1.03, 1.07)** ***	**1.04 (1.00, 1.08)** *	**1.12 (1.06, 1.17)** ***

All models additionally adjusted for patient sociodemographic characteristics at index visit (sex, age, race, insurance type, urbanicity, poverty level, unemployment rate, and median household income).

[a] Not adjusted for history of gastrointestinal visits (see Methods section).

* p-value<0.05,

** p-value<0.01,

*** p-value<0.001