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Risk of Pain Medication Misuse After Spinal Cord Injury: The Role of Substance Use, Personality, and Depression

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Abstract: **Our purpose was to identify risk of pain medication misuse (PMM) among participants with spinal cord injury (SCI) by examining associations with multiple sets of risk factors including demographic and injury characteristics, pain experiences, frequency of pain medication use, substance use, personality, and depressive symptoms. Risk of PMM was defined by a cutoff score ≥30 measured using the Pain Medication Questionnaire (PMQ) and examined in 1,619 adults with traumatic SCI of at least 1 year duration who reported at least 1 painful condition and use of prescription pain medication using a cross-sectional design. Results indicated 17.6% of participants had scores of ≥30 on the PMQ. After controlling for demographic, injury, and pain characteristics, logistic regression analysis showed that being a current smoker, recently using cannabis (behavioral factors), and multiple psychological factors were associated with risk of PMM, as indicated by scores on the PMQ. These included elevated depressive symptomatology and exhibiting impulsive or anxious personality traits. Because risk of PMM is indicated in individuals with SCI, prescribers should assess and monitor multiple risk factors for PMM including substance use behaviors and psychological indicators.**

Perspective: ***This article identifies behavioral substance use and psychological factors associated with risk of PMM, measured using the PMQ, among those with SCI. Identification of these related variables will help health care professionals better prescribe and monitor pain medication use and/or misuse among individuals with SCI.***

Key words: *Spinal cord injury, pain, personality, prescription drug misuse, medication.*

Pain is a frequent and debilitating health condition in individuals with spinal cord injury (SCI), with pain severity in persons with SCI higher than established norms in the general population.[21] Estimates have ranged widely, as 11 to 94% of persons with SCI have reported experiencing pain, with 18 to 63% reporting severe pain.[11,21,37] Those with pain have worse perceptions of global health and community reintegration, lower quality of life, poorer mental health, and poorer quality of sleep.[8,33,35,44] Given the high levels of perceived pain intensity and the effect of pain on physical, mental, and social health in individuals with SCI, understanding pain medication use behaviors, and potential for misuse is essential. Further, with increasing rates of overdose deaths in the general population due to opioid analgesics over the past decade, understanding and identifying risks associated with misuse is critical.[34,49]

Estimates suggest 3 to 78% of non-SCI patients with chronic pain misuse prescribed pain medications, with the wide range due to varying definitions of "misuse."[10,32,47] Previous studies using multivariate and regression analyses have indicated that patient characteristics such as younger age, having multiple mental health disorder diagnoses, being white, being male, smoking cigarettes, greater perceived pain-related limitations, and reporting greater subjective pain intensity ratings have been associated with higher risk of pain medication misuse (PMM) in non-SCI patients with chronic pain.[18,19,30,47] Further, a history of substance abuse, such as alcohol or cocaine abuse and cannabis use, has also been identified as predictive of opioid misuse.[18,36]

Studies on the relationship between personality traits and PMM are limited, and, to our knowledge, have not

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been conducted with a chronic pain sample. In a study on the association between substance abuse, drug of preference, and personality, 81 of 325 participants were classified as predominantly abusing opioid drugs and reported low constraint, described as behavioral disinhibition, impulsivity, and sensation-seeking. Those abusing opioids scored lower on this scale compared with other substance abuse categories (ie, marijuana and alcohol) and lower than individuals who did not abuse substances. There were no differences on the negative emotionality or positive emotionality factors.[6] Additional studies have supported the positive association between sensation-seeking and opioid use.[12,24] Further, a study on 5-factor personality traits in a small sample of Norwegian individuals with opioid dependence (n = 65) indicated higher scores on neuroticism and lower scores on conscientiousness and extraversion compared with a matched comparison group of individuals without opioid dependence.[23]

Research on prevalence and individual characteristics associated with PMM among those with SCI is limited. An early study, consisting of only 96 participants, indicated, of 43% reporting recent prescription medication use, that 24% reported using more than prescribed or using the medication without a prescription. However, this study did not solely focus on pain medication use but a variety of psychotropic medications.[14] A recent study of 919 participants who were prescribed pain medications indicated 25.8% of the sample reported PMM. Characteristics such as greater frequency of pain medication use, younger age, lower education, greater perceived pain severity, and greater perceived pain interference in daily activities were predictive of PMM.[26]

The current study fills an important gap in the existing SCI literature because it highlights behavioral and psychological characteristics associated with risk of PMM in a participant sample inclusive of clinical as well as population-based SCI cohorts. Previous studies in non-SCI populations have identified greater perceived pain intensity, cannabis use, elevated depressive symptoms, and sensation-seeking personality traits, experiences, and symptoms previously reported to be elevated in the SCI population,[7,21,36,38] are associated with greater risk of PMM and opioid abuse. To our knowledge, these associations have not yet been explored within the SCI population. Our purpose was to identify substance use and psychological indicators associated with risk of PMM, while controlling for demographic, injury, and pain characteristics. There were 2 study hypotheses: 1) Substance use, including frequent alcohol use, being a current smoker, and frequent use of cannabis, will be related to greater risk of PMM, assessed using responses to the Pain Medication Questionnaire (PMQ); 2) Psychological characteristics will be associated with risk of PMM, assessed using the PMQ, with those with greater sensation-seeking and neuroticism personality traits and elevated depressive symptomatology being at greater risk.

Materials and Methods

Participants

Institutional review board approval and a certificate of confidentiality protecting research information from forced disclosure in legal proceedings were obtained before study initiation. As part of a longitudinal study, clinical and population-based cohorts were identified. The clinical cohort included participants identified through the Georgia Regional SCI Model Systems, from which eligible inpatients as well as outpatients were approached to participate. The population-based cohort was identified through the South Carolina SCI Surveillance System Registry, a population-based registry of SCI occurring in the state of South Carolina each year. This registry contains discharge and hospitalization data involving SCI, mandated by all nonfederal hospitals in South Carolina. Inclusion criteria for both cohorts were: 1) 18 years of age or older at time of study, 2) 1 year had passed since traumatic SCI, and 3) some residual impairment.

There were a total of 2,522 participants from both participant cohorts, including 1,689 from the clinical cohort and 833 from the population-based state surveillance registry. Data describing PMM from a subsample of the clinical participants while the study was ongoing has been reported elsewhere, yet factors associated with risk of PMM were not examined.[26] The response rate for the clinical sample (81%) was higher than for the surveillance cohort (40%), likely because of more significant difficulties in finding accurate addresses and phone numbers for the surveillance participants (details on sampling have been described elsewhere).[26,41] Additional eligibility criteria for the present study eliminated those who did not report at least 1 painful condition and were not using at least some prescription pain medication. Of the 1,655 remaining respondents, 1,461 completed all items of the PMQ. If participants answered at least 23 of the 26 items of the PMQ, then a total score was extrapolated by dividing the total score by the number of items included in that score and then multiplying by 26. This extrapolation method is consistent with previous literature using the PMQ and was used for 158 participants, resulting in a sample size of 1,619 (Fig 1).[9]

Procedures

Participants were enrolled using mailed assessments distributed between 2010 and 2013. Cover letters, which included all elements of informed consent and described the study, were sent 4 to 6 weeks before the actual assessment package. Return of a completed assessment implied consent as approved by the institutional review board. Those who did not respond to the first set of materials received a second set of materials. One follow-up phone call was made to bolster participation. Some individuals requested a third set of materials and agreed to be called again to confirm receipt of materials and answer any remaining questions. Participants were offered $50 in remuneration.

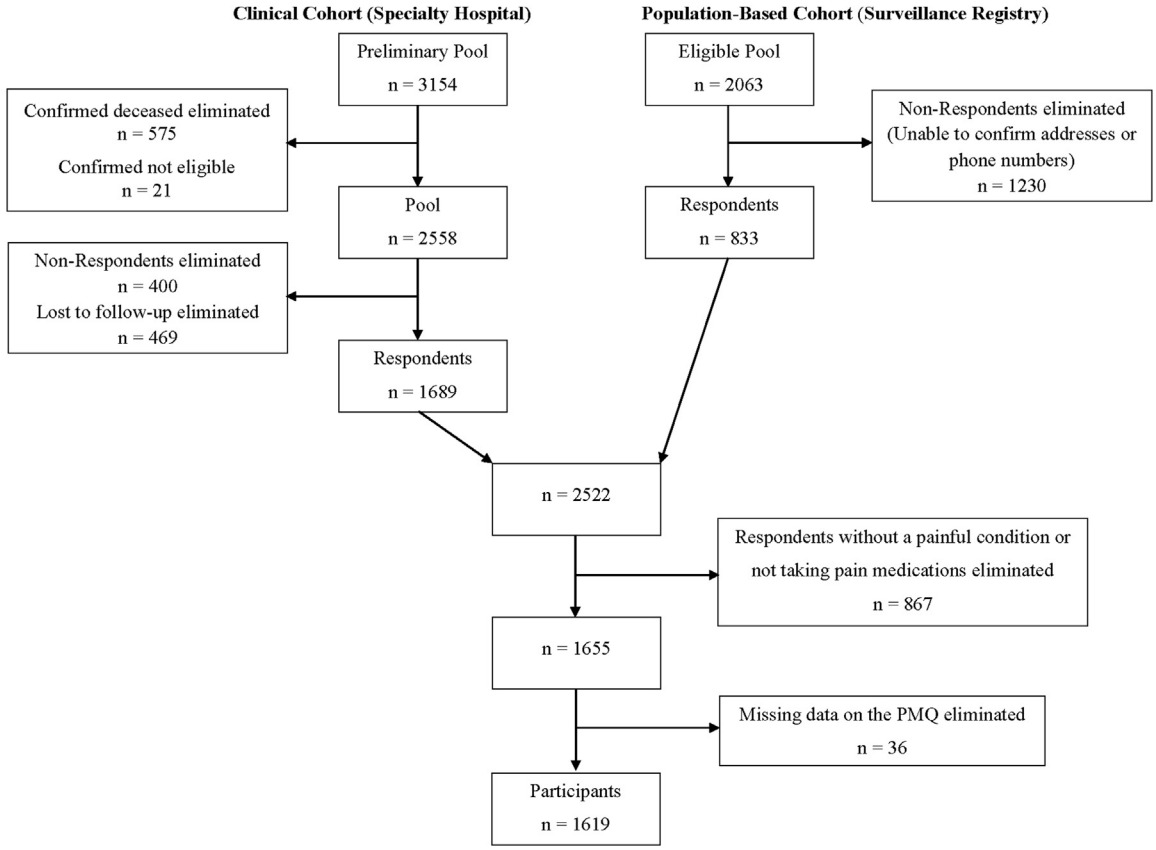

Figure 1. Participant sample size as related to nonresponse, study eligibility criteria, and missing data.

Measures

Participant Characteristics and Pain Experiences

Participant characteristics included: age, race/ethnicity (white, non-Hispanic; black, non-Hispanic; other), and education (less than high school, high school diploma or some college, 4-year college degree or higher). Years since injury was gathered as an injury characteristic variable. Injury severity was categorized using a combination of injury level and ambulatory status as follows: C1 to C4, nonambulatory; C5 to C8, nonambulatory; noncervical, nonambulatory; and ambulatory (regardless of level). Ambulatory status serves as a self-report proxy measure for the American Spinal Injury Association Impairment Scale D, and this categorization of injury severity is consistent with previous literature.[39,42]

Pain intensity and interference of pain on functioning were assessed using 2 items from the Brief Pain Inventory.[4,5] Participants responded by rating their pain from 0 (ie, "no pain") to 10 (ie, "pain as bad as you can imagine") to indicate the pain they experience on average.[5] Participants rated the interference of pain on mood and physical functioning on a scale from 0 (ie, "does not interfere") to 10 (ie, "completely interferes") with the following activities in the past week: 1) general activity, 2) mood, 3) walking ability, 4) normal work, 5) relations with others, 6) sleep, and 7) enjoyment of life. The average pain interference score was calculated for persons who answered more than half of the items.[4] For those who were nonambulatory, they could choose to not respond to the "walking ability" item and still receive an interference score if they responded to at least half of the items. Those who were nonambulatory could also decide to respond to the item, with most of those who were nonambulatory and who did respond to the item indicating that pain "does not interfere" with their walking ability.

Frequency of prescription pain medication use was assessed by asking participants the frequency with which they used prescribed pain medications in the past 12 months with the following response options: 1) never, 2) sometimes, 3) weekly, and 4) daily.[22,25,27]

Substance Use

Alcohol use and smoking status were assessed with 3 items from the Behavioral Risk Factor Surveillance System.[3] Alcohol use in the past month was assessed by asking participants to indicate the number of days in the past month they drank any alcoholic beverages. Two items were used to assess cigarette use status: 1) "Have you smoked at least 100 cigarettes in your entire life?" and 2) "Do you smoke right now?" Participants were defined as nonsmokers (had never smoked 100 cigarettes), former smokers (had smoked 100 cigarettes, but did not smoke currently), and current smokers (had smoked 100 cigarettes and currently smoked). One item from the World Health Organization Alcohol, Smoking, and Substance

Table 1. Descriptive Statistics and Bivariate Comparisons of Participant Characteristics

	Total Sample (N = 1,619)	*PMQ <30 (N = 1,334)*	*PMQ ≥30 (N = 285)*	
Participant Characteristic		%		χ^2 *(df)*
Gender				.79 (1)
Male (n = 1,158)	71.5	71.1	73.7	
Female (n = 461)	28.5	28.9	26.3	
Race/ethnicity				9.77 (2)*
White, non-Hispanic (n = 1,077)	66.5	68.2	58.6	
Black, non-Hispanic (n = 447)	27.6	26.2	34.0	
Other (n = 95)	5.9	5.5	7.4	
Education†				8.10 (2)*
Less than high school (n = 220)	13.6	12.6	18.2	
High school diploma/some college (n = 846)	52.3	52.2	52.6	
Four-year college degree or higher (n = 553)	34.2	35.2	29.1	
Injury severity				8.76 (3)*
C1-C4, nonambulatory (n = 143)	8.9	9.3	7.4	
C5-C8, nonambulatory (n = 308)	19.3	20.3	14.2	
Noncervical, nonambulatory (n = 447)	28.0	27.9	28.0	
Ambulatory (n = 701)	43.8	42.4	50.4	
Frequency of pain medication use				33.08 (2)**
Sometimes (n = 425)	26.4	29.2	13.1	
Weekly (n = 128)	7.9	8.1	7.4	
Daily (n = 1,059)	65.7	62.8	79.5	
Smoking status				92.64 (2)**
Nonsmoker (n = 661)	41.6	44.6	27.9	
Former smoker (n = 465)	29.3	31.4	19.4	
Current smoker (n = 462)	29.1	24.0	52.7	
Cannabis use				76.01 (2)**
Nonuser (n = 1,313)	84.0	87.5	66.8	
Occasional user (n = 136)	8.7	6.3	20.3	
Frequent user (n = 115)	7.3	6.2	12.9	
Depression‡				115.97 (1)**
Minimal depression (n = 1,042)	65.9	71.9	38.0	
Elevated depression (n = 538)	34.1	28.1	62.0	
		Mean (SD)		*t (df)*
Age in years (n = 1,616)	49.3 (14.2)	50.0 (14.3)	45.5 (13.4)	4.91 (1,614)**
Years since injury (n = 1,615)	11.5 (9.2)	11.8 (9.3)	10.3 (8.6)	2.53 (433.33)*
Pain in past 30 days	14.1 (11.4)	12.8 (11.2)	20.3 (10.2)	−11.04 (443.26)**
Average pain intensity (n = 1,602)	5.7 (2.2)	5.4 (2.2)	7.0 (2.0)	−12.35 (433.75)**
Pain interference (n = 1,588)	4.5 (3.0)	4.0 (2.8)	6.6 (2.6)	−14.88 (426.98)**
Days using alcohol (n = 1,589)	3.7 (6.9)	3.5 (6.8)	4.5 (7.2)	−.1.97 (382.33)*
ZKPQ activity (n = 1,507)	5.0 (2.1)	5.0 (2.1)	5.0 (2.0)	.41 (1,505)
ZKPQ aggression/hostility (n = 1,543)	4.9 (2.0)	4.7 (1.9)	5.6 (1.9)	−7.02 (1,541)**
ZKPQ sociability (n = 1,526)	5.2 (1.6)	5.2 (1.6)	5.4 (1.6)	−1.66 (1,524)
ZKPQ impulsivity/sensation-seeking (n = 1,554)	3.9 (2.7)	3.7 (2.7)	4.9 (2.6)	−6.87 (1,552)**
ZKPQ neuroticism/anxiety (n = 1,535)	3.7 (2.5)	3.4 (2.4)	5.2 (2.6)	−9.96 (355.68)**
PMQ (n = 1,619)	20.7 (10.5)	17.0 (6.4)	38.2 (8.0)	N/A§

Abbreviation: N/A, not applicable.

*$P \leq .05$.

**$P \leq .001$.

†For some variables, there was a limited amount of nonrespondents. The number of responses in each category are placed with each particular category, but the percentages in the table have been adjusted for nonrespondents.

‡Elevated depressive symptomatology was defined as a score of ≥4 assessed according to 3 items from the Patient Health Questionnaire-9, with minimal depressive symptoms defined by a score <4.

§*P* value not provided because the PMQ score is used to determine the PMQ cut point.

Involvement Screening Test was used to examine recent cannabis use.[16] Participants were asked to indicate how often they used cannabis (eg, marijuana, pot, grass, hash) in the past 3 months. Response options were: 1) never, 2) once or twice, 3) monthly, 4) weekly, or 5) daily/almost daily. Participants were then categorized into nonusers (never), occasional users (once or twice or monthly), or frequent users (weekly or daily/almost daily).

Table 2. Item Responses on PMQ According to PMM Group

	PMQ <30					PMQ ≥30				
Item	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree
1. I believe I am receiving enough medication to relieve my pain	144 (10.8)	187 (14.0)	205 (15.4)	286 (21.4)	509 (38.2)	126 (44.4)	61 (21.5)	34 (12.0)	39 (13.7)	24 (8.5)
2. My doctor spends enough time talking to me about my pain medication during appointments	79 (5.9)	84 (6.3)	201 (15.1)	207 (15.5)	762 (57.2)	77 (27.2)	52 (18.4)	57 (20.1)	36 (12.7)	61 (21.6)
3. I believe I would feel better with a higher dosage of my pain medication	505 (38.0)	138 (10.4)	306 (23.0)	227 (17.1)	152 (11.4)	22 (7.8)	16 (5.7)	37 (13.1)	6 (23.4)	141 (50.0)
4. In the past, I have had some difficulty getting the medication I need from my doctor(s)	902 (67.7)	86 (6.5)	126 (9.5)	120 (9.0)	98 (7.4)	45 (15.8)	22 (7.7)	43 (15.1)	58 (20.4)	117 (41.1)
5. I wouldn't mind quitting my current pain medication and trying a new one, if my doctor recommends it	329 (24.8)	63 (4.7)	302 (22.7)	220 (16.6)	415 (31.2)	40 (14.1)	26 (9.2)	50 (17.6)	54 (19.0)	114 (40.1)
6. I have clear preferences about the type of pain medication I need	230 (17.5)	87 (6.6)	370 (28.1)	224 (17.0)	406 (30.8)	20 (7.1)	21 (7.4)	61 (21.6)	67 (23.7)	114 (40.3)
7. Family members seem to think that I may be too dependent on my pain medication	1,043 (78.7)	91 (6.9)	121 (9.1)	44 (3.3)	26 (2.0)	132 (46.8)	24 (8.5)	41 (14.5)	37 (13.1)	48 (17.0)
8. It is important to me to try ways of managing my pain in addition to the medication	144 (10.9)	51 (3.8)	253 (19.1)	231 (17.4)	646 (48.8)	36 (12.7)	22 (7.8)	44 (15.5)	55 (19.4)	126 (44.5)
	Never	Occasionally	Sometimes	Often	Always	Never	Occasionally	Sometimes	Often	Always
9. At times, I take pain medication when I feel anxious and sad, or when I need help sleeping	886 (66.6)	226 (17.0)	155 (11.6)	36 (2.7)	28 (2.1)	90 (31.6)	54 (18.9)	68 (23.9)	37 (13.0)	36 (12.6)
10. At times, I drink alcohol to help control my pain	1,152 (87.5)	93 (7.1)	53 (4.0)	13 (1.0)	5 (.4)	190 (68.6)	34 (12.3)	30 (10.8)	16 (5.8)	7 (2.5)
11. My pain medication makes it hard for me to think clearly sometimes	973 (73.3)	195 (14.7)	121 (9.1)	29 (2.2)	10 (.8)	134 (47.3)	56 (19.8)	59 (20.8)	25 (8.8)	9 (3.2)
12. I find it necessary to go to the emergency room to get treatment for my pain	1,197 (89.9)	89 (6.7)	38 (2.9)	3 (.2)	5 (.4)	151 (53.0)	52 (18.2)	53 (18.6)	16 (5.6)	13 (4.6)
13. My pain medication makes me nauseated and constipated sometimes	788 (59.3)	248 (18.7)	194 (14.6)	70 (5.3)	29 (2.2)	73 (25.7)	62 (921.8)	84 (29.6)	37 (13.0)	28 (9.9)
14. At times, I need to borrow pain medication from friends or family to get relief	1,260 (94.7)	52 (3.9)	16 (1.2)	1 (.1)	1 (.1)	172 (60.4)	43 (15.1)	45 (15.8)	16 (5.6)	8 (2.8)
15. I get pain medication from more than one doctor in order to have enough medication for my pain	1,313 (98.4)	11 (.8)	5 (.4)	1 (.1)	4 (.3)	242 (85.5)	15 (5.3)	11 (3.9)	6 (2.1)	9 (3.2)
16. At times, I think I may be too dependent on my pain medication	1,119 (84.1)	131 (9.8)	60 (4.5)	15 (1.1)	6 (.5)	153 (54.3)	44 (15.6)	41 (14.5)	28 (9.9)	16 (5.7)
17. To help me out, family members have obtained pain medications for me from their own doctors	1,330 (99.7)	4 (.3)	0	0	0	256 (89.8)	14 (4.9)	10 (3.5)	3 (1.1)	2 (.7)
18. At times, I need to take pain medication more often than it is prescribed in order to relieve my pain	977 (73.3)	240 (18.0)	99 (7.4)	9 (.7)	7 (.5)	64 (22.7)	55 (19.5)	87 (30.9)	51 (18.1)	25 (8.9)
19. I save any unused pain medication I have in case I need it later	708 (53.5)	262 (19.8)	147 (11.1)	65 (4.9)	142 (10.7)	67 (23.5)	35 (12.3)	66 (23.2)	40 (14.0)	77 (27.0)

Table 2. Continued

	Never	Occasionally	Sometimes	Often	Always
20. I find it helpful to call my doctor or clinic to talk about how my pain medication is working	893 (67.5)	205 (15.5)	144 (10.9)	28 (2.1)	53 (4.0)
21. At times, I run out of pain medication early and have to call my doctor for refills	1,136 (85.3)	124 (9.3)	57 (4.3)	10 (.8)	5 (.4)
22. I find it useful to take additional medications (such as sedatives) to help my pain medication work better	1,191 (89.6)	93 (7.0)	31 (2.3)	11 (.8)	3 (.2)

	1	2	3	4	5+
23. How many painful conditions do you have?	409 (31.0)	414 (31.4)	248 (18.8)	109 (8.3)	139 (10.5)

	Never	1 Time	2 Times	3 Times	≥4 Times
24. How many times in the past year have you asked your doctor to increase your prescribed dosage of pain medication in order to get relief?	959 (72.1)	277 (20.8)	75 (5.6)	11 (.8)	9 (.7)
25. How many times in the past year have you run out of pain medication early and had to request an early refill?	1,162 (87.4)	99 (7.4)	52 (3.9)	13 (1.0)	4 (.3)
26. How many times in the past year have you accidentally misplaced your prescription for pain medication and had to ask for another?	1,285 (96.5)	34 (2.6)	10 (.8)	2 (.2)	0

	Never	Occasionally	Sometimes	Often	Always
20. I find it helpful to call my doctor or clinic to talk about how my pain medication is working	126 (44.4)	52 (18.3)	51 (18.0)	22 (7.7)	33 (11.6)
21. At times, I run out of pain medication early and have to call my doctor for refills	97 (34.2)	66 (23.2)	73 (25.7)	26 (9.2)	22 (7.7)
22. I find it useful to take additional medications (such as sedatives) to help my pain medication work better	150 (52.8)	52 (18.3)	46 (16.2)	22 (7.7)	14 (4.9)

	1	2	3	4	5+
23. How many painful conditions do you have?	33 (11.8)	51 (18.2)	77 (27.5)	37 (13.2)	82 (29.3)

	Never	1 Time	2 Times	3 Times	≥4 Times
24. How many times in the past year have you asked your doctor to increase your prescribed dosage of pain medication in order to get relief?	79 (27.8)	79 (27.8)	68 (23.9)	28 (9.9)	30 (10.6)
25. How many times in the past year have you run out of pain medication early and had to request an early refill?	110 (39.3)	60 (21.4)	54 (19.3)	25 (8.9)	31 (11.1)
26. How many times in the past year have you accidentally misplaced your prescription for pain medication and had to ask for another?	225 (79.2)	36 (12.7)	11 (3.9)	8 (2.8)	4 (1.4)

Psychological Indicators

An abbreviated version of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) was used to examine personality constructs. This 50-item version provides information on 5 dimensions of personality, called the alternative 5, including: 1) impulsive sensation-seeking, 2) neuroticism/anxiety, 3) aggression/hostility, 4) sociability, and 5) activity. Impulsive sensation-seeking measures a lack of planning and tendency to act impulsively. Neuroticism/anxiety measures tension, worry, and fearfulness, with most items highlighting cognitive symptoms of anxiety (eg, "I often feel unsure of myself"). Aggression/hostility expresses rude, thoughtless, or antisocial behavior. Activity reflects the need for high-energy activity, and sociability describes social contacts and friends. The ZKPQ was developed within the general population and has been reported to be reliable in an American sample.[2,52]

Three items from the Patient Health Questionnaire (PHQ)-9[28,29] were used to assess depression. These 3 items (PHQ-3) have been supported in the SCI literature as an acceptable approach in depression screening compared with the PHQ-9.[13] The 3 items inquire about the experience of "little interest or pleasure in doing things," "feeling down, depressed, or hopeless," and "feeling bad about yourself—or that you are a failure or have let yourself or your family down" in the previous 2 weeks. Scored 0 to 3, respectively, the response options are: "not at all," "several days," "more than half of the days," or "nearly every day." All items were summed with potential total scores ranging from 0 to 9. Scores were dichotomized, using a suggested cutoff of ≥4 as indicative of elevated depressive symptomatology, and scores <4 indicative of minimal depressive symptoms.[13]

PMM

The PMQ is a 26-item self-report measure designed to assess risk for PMM in individuals with pain syndromes.[1] Example items from the PMQ include: "At times, I need to take pain medication more often than it is prescribed in order to relieve my pain," and "I get pain medication from more than one doctor in order to have enough medication for my pain." Response options, scored 0 to 4, are arranged in a 5-point Likert format indicating the degree of agreement or behavioral conformity to each item. Total scores range from 0 to 104, with scores of ≥25 suggested to reflect medication use behaviors predictive of future problematic use and associated with greater subjective disability and lower level of functioning.[9,26,40] A score of ≥30 has been suggested as indicative of more serious aberrant drug-taking behaviors (eg, prescription forging and using other's prescriptions),[9,15] and this cutoff score was used to define risk of PMM in the current study. Preliminary analyses have shown acceptable reliability coefficients and validity because higher PMQ scores were associated with higher levels of psychosocial distress, poorer functioning, and a history of substance abuse.[1,15]

Data Analysis

SPSS 21[17] was used for descriptive statistics, instrument reliability examination, and bivariate analyses. Descriptive statistics were computed for participant characteristics, medication use, pain experiences, substance use, and psychological variables. Cronbach α was used to examine PMQ reliability. T-tests and the χ^2 statistic were used to identify demographic characteristics, pain experiences, substance use, personality indicators, and depressive symptom associations with risk of PMM, on the basis of a cutoff score of ≥30. Pearson correlation coefficients were used to assess relationships between PMQ total score, age, duration of injury, pain indicators, personality scales, and depressive symptom total scores.

A 3-stage logistic regression, using SAS (version 9.4, SAS Institute Inc, Cary, NC), was performed to identify factors associated with risk of PMM. To compare relative effects of the independent variables on risk of PMM, continuous variables were standardized for inclusion in the logistic regression analyses. The first stage of the model included demographic characteristics, variables associated with pain experiences, and frequency of pain medication use as statistical controls. Substance use variables were entered in the second stage. The ZKPQ scales and depressive symptomatology were added in the third stage after controlling for all other variables.

There were 260 participants with item-level missing data on the ZKPQ scales. Multiple imputation to address these missing data was done using the Markov chain Monte Carlo algorithm, which involves 4 steps. First, all variables used in the final model and 1 more auxiliary variable, depression total score, were chosen to impute the missing data. Second, the SAS PROC MI procedure was used on the specified set of variables to produce 5 imputed data sets. Third, the PROC LOGISTIC procedure was performed to estimate the final model without the auxiliary variable on each imputed data set. Finally, the PROC MIANALYZE procedure combined results into a single set of parameter estimates, standard error, and test statistics.

Results

Descriptive

Most participants reported having 1, 2, or 3 painful conditions (27.6%, 29.1%, and 20.3%, respectively), whereas 22.9% reported ≥4 painful conditions. Participants experienced pain an average of 14.14 (SD = 11.35) days in the previous month, with an average pain intensity of 5.7 (SD = 2.2) on a scale of 0 to 10 (range = 0–10, with 5 participants reporting an average intensity of 0 and 44 participants reporting an average intensity of 1). Approximately 17.7% of participants experienced mild pain on average (range = 0–3), 44.3% experienced moderate pain on average (range = 4–6), and 38.0% experienced severe pain on average (range = 7–10) in the previous month. Most participants had frequent pain medication use (ie, 65.7% used pain medications daily; Table 1). Approximately 29.6% of the participants had a score of ≥25 on the PMQ, suggestive of potential for problematic medication misuse, whereas 17.6% had a score ≥30, used to define risk of PMM in this study. The reliability of the PMQ scale for the current study was acceptable (r = .75). Itemized results of the PMQ are reported in Table 2.

Bivariate Analyses

All variables except gender and the ZKPQ activity as well as sociability scales were significantly related to risk of PMM as indicated by bivariate analyses (Table 1). Significant correlations were found between PMQ total score and participant age, duration of injury, perceived interference of pain on functioning, and average pain intensity (Table 3). Pain interference and average pain intensity were moderately associated with PMQ total score. With the exception of activity, all ZKPQ scales were found to be positively associated with PMQ total score, with neuroticism/anxiety moderately related. Depression, measured according to the total score on the PHQ-3, also was moderately associated with PMQ total score.

Table 3. Correlation Matrix Between PMQ Total, Demographic and Pain Characteristics, Personality Indicators, and Depressive Symptomatology

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. PMQ total	—									
2. Age	−.13**	—								
3. Duration of injury	−.06*	.17**	—							
4. Pain interference	.48**	.00	−.11**	—						
5. Average pain intensity	.41**	−.02	−.08*	.59**	—					
ZKPQ Scales										
6. Activity	−.01	−.01	−.03	−.09**	.03	—				
7. Aggression/hostility	.23**	−.22**	−.06*	.13**	.13**	.12**	—			
8. Sociability	.12**	−.07*	−.03	.03	.09**	.25**	.19**	—		
9. Impulsivity/sensation-seeking	.18**	−.26**	−.05*	.03	.05	.38**	.34**	.24**	—	
10. Neuroticism/anxiety	.34**	−.09**	−.11**	.37**	.19**	−.11**	.26**	.16**	.11**	—
11. PHQ-3 total	.39**	−.06*	−.13**	.52**	.30**	−.19**	.19**	.07*	.08**	.55**

*$P \leq .05$.
**$P \leq .001$.

Table 4. Three-Stage Logistic Regression Model

	Stage 1	Stage 2	Stage 3
Variable	Odds Ratio (95% Confidence Interval)		
Age	**.95 (.94–.97)*** **	**.97 (.95–.99)*** **	.99 (.97–1.01)
Years since injury	1.01 (.99–1.03)	1.01 (.99–1.03)	1.01 (.99–1.03)
Education (vs 4-year college degree or higher)			
Less than high school	1.00 (.64–1.57)	.95 (.58–1.56)	.91 (.57–1.46)
High school diploma/some college	.95 (.68–1.33)	.91 (.63–1.31)	.89 (.63–1.26)
Race/ethnicity (vs white, non-Hispanic)			
Black, non-Hispanic	**1.51 (1.10–2.09)***	**1.79 (1.26–2.54)*** **	**1.97 (1.40–2.78)*** **
Other	1.25 (.69–2.26)	1.27 (.65–2.48)	1.29 (.69–2.42)
Injury severity (vs ambulatory)			
C1-C4, nonambulatory	.63 (.36–1.10)	.86 (.48–1.53)	.75 (.42–1.33)
C5-C8, nonambulatory	.80 (.52–1.24)	.88 (.54–1.43)	.97 (.61–1.54)
Noncervical, nonambulatory	.87 (.61–1.24)	.96 (.65–1.41)	1.00 (.69–1.46)
Pain interference	**1.10 (1.08–1.12)*** **	**1.10 (1.08–1.13)*** **	**1.08 (1.06–1.10)*** **
Average pain intensity	1.00 (.99–1.01)	1.00 (.98–1.01)	1.00 (.97–1.03)
Frequency of pain medication use (vs sometimes)			
Weekly	1.63 (.86–3.10)	1.46 (.72–2.98)	1.76 (.90–3.44)
Daily	**1.96 (1.30–2.96)** **	**1.96 (1.26–3.06)** **	**2.13 (1.39–3.27)*** **
Days using alcohol		**1.02 (1.01–1.04)** **	1.01 (1.00–1.03)
Smoking status (vs non-smoker)			
Former		1.04 (.68–1.60)	.95 (.63–1.44)
Current		**2.35 (1.60–3.46)*** **	**2.05 (1.41–2.97)*** **
Cannabis use (vs nonuser)			
Occasional use		**2.91 (1.83–4.62)*** **	**2.66 (1.67–425)*** **
Frequent use		**1.90 (1.13–3.20)***	**1.79 (1.05–3.04)***
ZKPQ activity			1.00 (.98–1.02)
ZKPQ aggression/hostility			1.01 (.99–1.02)
ZKPQ sociability			.99 (.97–1.00)
ZKPQ impulsivity/sensation-seeking			**1.04 (1.02–1.06)*** **
ZKPQ neuroticism/anxiety			**1.03 (1.01–1.05)** **
Depression (vs minimal; ≤3)			
Elevated			**1.61 (1.13–2.29)** **

NOTE. All continuous variables (age, years since injury, pain interference, average pain intensity, days using alcohol, and the ZKPQ scales) were standardized. Values in **bold** identify significant variables at differing stages of the model.
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .001$.

Logistic Regression

In stage 1, age, race, pain interference, and frequency of pain medication use were associated with risk of PMM (Table 4). Those who were younger and those who had higher perceived interference from pain were more likely to report risk of PMM. Compared with individuals who were white, non-Hispanic, those who were black, non-Hispanic were 1.51 times more likely to report risk of PMM. Compared with individuals who reported sometimes using pain medications, those who used prescription pain medications daily had 96% greater odds of indicating risk of PMM, respectively.

Each of the 3 risk behaviors was significant upon their addition in stage 2. For alcohol use, there was a 2% increase in the odds of risk of PMM for each SD of days using alcohol in the past month. Compared with those who were nonsmokers, current smokers had 2.35 greater odds of risk of PMM. Nonsmokers and former smokers did not differ in risk of PMM. Those who used cannabis occasionally and frequently were 2.91 and 1.90 times more likely to report risk of PMM than those who were nonusers in the previous 3 months, respectively. Age, race, perceived pain interference, and frequency of pain medication use remained significant in stage 2.

Several psychological characteristics were significant in the final model. Two of the ZKPQ personality scales (neuroticism/anxiety and impulsive sensation-seeking) were associated with risk of PMM, with every 1 SD increase on these scales indicating a 3.0% and 4.0% increase in the odds of risk of PMM, respectively. Depressive symptomatology was associated with risk of PMM, with persons with elevated depressive symptoms being 1.61 times more likely to experience risk of PMM than those with minimal symptoms. Of the risk behaviors, only smoking and cannabis use remained significant, because current smokers' odds of risk of PMM were 2.05 times the odds of nonsmokers, and occasional and frequent cannabis users' odds were 2.66 and 1.79 times the odds of nonusers, respectively. Race, perceived pain interference, and frequency of pain medication use also remained significant.

Discussion

Individuals with SCI who experience a painful condition and are prescribed pain medications may be at risk for PMM. The present study's sample experienced frequent pain, moderate average pain intensity (5.7, SD = 2.2), and frequent pain medication use (65.7% using daily). Almost 30% of participants reported PMQ scores suggestive of potential for problematic PMM (≥25) and 17.6% had scores indicative of risk of more serious aberrant pain medication use behaviors. The prevalence of risk of PMM within our sample is consistent with previous estimates in SCI samples[14,26] and is within the range reported in non-SCI samples.[10,32,47]

Our findings provide further evidence of the relationship between sociodemographic characteristics and risk of PMM, although contrast findings in non-SCI samples and previous literature.[10,26,43,47,51] With the addition of substance use and psychological variables, age was not found to be significantly associated with risk of PMM in our findings, contrary to previous literature.[10,26,43,47] Previous research in non-SCI samples has indicated that white individuals have a higher likelihood of opioid misuse.[10,51] Our results differ because black, non-Hispanic participants were 2.00 times more likely to report risk of PMM than white, non-Hispanic participants.

Participant pain experiences were associated with risk of PMM. Those with greater perceived interference of pain on functioning had greater risk of misuse.

Surprisingly, although pain-related limitations were related to risk of PMM, pain severity was not, which is in contrast with previous literature.[19] This finding presents mixed evidence of the relationship between pain severity and risk of PMM, because a previous examination of PMM in SCI showed average pain severity to be significantly associated with PMM. However, the previous study was limited to a smaller sample size of individuals only recruited from a specialty hospital and used a cutoff score of ≥25 on the PMQ to define PMM.[26] Taken together, these findings may suggest that misuse behaviors are associated with alleviating or coping with the functional limitations brought on by pain, rather than alleviating the pain itself. Further research should continue to examine risk of PMM in relation to limited functioning and pain severity within individuals with SCI. Frequency of prescribed pain medication use was also significantly related to risk of PMM, with odds of risk of misuse increasing with more frequent use and those taking prescribed medication daily being 2.13 times more at risk of misusing these medications than those who sometimes used prescribed pain medications. This dose-response relationship may reflect the development of physical dependence associated with regular use of substances.

The addition of substance use variables to the model provided further evidence of the association between use of other substances and risk for misusing pain medications. Occasional as well as frequent cannabis use and being a current smoker had similar contributions to risk of PMM and support our hypotheses. Those who used cannabis occasionally and frequently were 2.66 and 1.79 times more likely to report risk of PMM, respectively. This is consistent with non-SCI literature[18] and is timely in consideration of the changing state laws and access to cannabis for medical necessities. Among those with chronic pain prescribed opioid therapy, it is estimated that 6.2 to 39% of patients use cannabis, which is greater than the estimated 5.8% in the general population.[36] Approximately 8.7% of participants in the current study reported occasional recent use of cannabis and 7.4% reported recent frequent use of cannabis, and cannabis use among those with SCI also has been estimated to be greater than in the general population,[48] supporting the need for prescribers to assess and monitor cannabis use in pain management for those with SCI. Current cigarette smoking was associated with risk of PMM, with current smokers 2.05 times more at risk of misuse. Upon the inclusion of psychological factors to the model, recent alcohol use no longer explained unique variance in the model, which is inconsistent with our hypotheses. Our findings suggest risk of PMM may be part of a more general pattern of substance use and misuse.

Personality predictors have been widely examined in relation to substance abuse behavior; however, there is limited literature on the relationship of personality factors with risk of PMM, especially in those experiencing pain. Our results do support the association of more impulsive and neurotic personality tendencies with higher likelihood of risk of PMM. Disinhibition or sensation-seeking tendencies have been associated with substance abuse behaviors, including opioid misuse behaviors in non-SCI populations.[6] Because impulsivity and sensation-seeking personality traits have been noted as prevalent in SCI,[38] the instances of greater impulsivity among those with SCI seeking pain management treatment may be greater than in the non-SCI population seeking similar services. Greater neuroticism and anxiety tendencies were also associated with greater likelihood of risk of PMM. This again may reflect the alternative use of pain medications to cope with distress and stressors, and it is interesting to note the moderate correlation between the ZKPQ neuroticism/anxiety scale and pain interference on functioning (.37). Additional findings in this study suggest misuse of pain medications as a coping strategy, because depressive symptomatology was related to risk of PMM. Those with elevated scores were 1.61 times more likely to endorse risk of PMM than those with minimal depressive symptoms. Results also indicated that elevated depressive symptomatology was highly positively correlated with pain interference (.52) and neuroticism/anxiety (.55).

Clinical Implications

Prescriptions for pain medications and nonmedical use of prescription pain relievers have increased greatly over the past 25 years.[31] With increase in use, there is increased risk of dependence and an increase in deaths due to opioid overdose.[34,49] It is important for health care professionals to assess and monitor risk for PMM to reduce detrimental outcomes. This study used a population-based cohort, which is a more inclusive

representation of individuals with SCI within the geographic region, in addition to a clinical cohort and identifies indicators that will assist professionals in assessing and managing care for individuals with SCI seeking pain relief. Identification of those at high risk for PMM will support referral for a more thorough evaluation of pain medication use behaviors and, if appropriate on the basis of further evaluation, referral to systems, such as cognitive behavioral counseling, that promote beneficial pain management outcomes.[20]

Study Limitations

Response bias may be indicated because all data were self-reported. Several variables within the study are sensitive in nature (ie, medication misuse, alcohol use, smoking status, and cannabis use). To limit bias and the possibility of under-reporting, standardized and validated measures were used. Because risk of PMM was assessed using a self-report measure, data (eg, pharmacy fill records) are not available to confirm PMM. We used a conservative cutoff (ie, ≥30) on the PMQ to define risk of PMM, a cutoff that has been suggested as an indicator of aberrant drug-related behaviors.[9,15] Further, the PMQ language does not limit responses solely to use of opioids but, rather, inquires about use of "pain medications." Therefore, the presented results are not unique to misuse of opioids and rather are reflective of a more inclusive risk of PMM. Individuals may categorize "pain medications" as a variety of medications, each with differing risk profiles for misuse. For instance, opioids such as hydromorphone and oxycodone are considered Schedule II narcotics with high potential for abuse and psychological/physical dependence, whereas Schedule III (eg, Tylenol with codeine, ketamine) drugs are considered to have lower risk of abuse compared with Schedule II, and Schedule IV (eg, tramadol) drugs are considered to have lower risk of abuse compared with Schedule III medications. Further, Schedule V substances (eg, pregabalin) have low potential for abuse relative to other controlled substance classifications that may be prescribed, as well as noncontrolled substances (eg, gabapentin), to treat pain. The current study was not able to differentiate between schedule of pain medication, specific types of prescription pain medication used, or number of prescribed pain medications used; therefore, risk indicators specific to classification of medication, type of pain medication, or quantity of pain medication could not be identified. The analyses all reflect cross-sectional data, so the relationships between risk of PMM and predictor variables are at a single point in time. Attrition is always a concern in any study and could have had unknown effects on the current findings.

Data were not available for specific type of pain (ie, neuropathic or nociceptive) to allow differentiation between these type groups; however, factors associated with neuropathic pain occurrence in SCI (ie, completeness of injury via injury severity) were examined and controlled for in relation to risk of PMM.[50] Data were limited to recent substance use indicators (eg, frequency of alcohol use in past month) rather than substance abuse history (eg, alcohol dependence). As such, the relationships found in this study between substance use and risk of PMM may be underestimated.

Last, our sample only included individuals residing in the southeastern United States, thus generalizability to individuals with SCI outside of this region must be considered. Other demographic characteristics (ie, sex, education, sampling procedures) are fairly representative.

Future Research

Because of the prevalence of elevated pain and risk of PMM, more research is necessary to address the limited scope of research on this topic. Examining aberrant drug-taking behaviors via clinical and medical record data to further assess PMM and associated factors and outcomes for those with SCI would be beneficial. Future research should assess misuse potential and associated risk factors for specific types of pain medications among those with SCI. Further examination of substance abuse histories in relation to PMM in this population is also suggested to provide a more complete understanding of the role of substance use behavior in PMM. Causality cannot be determined in light of the cross-sectional nature of the present study. Longitudinal research is needed to identify a time frame of these construct associations and determine its consistency with causality. Empirically supported intervention approaches to prevent or treat PMM are not only desirable but desperately needed. From a psychometric perspective, further statistical analyses (eg, item response theory) evaluating the content (eg, somatic items), and length of the PMQ and the ZKPQ within this population would also be clinically and empirically beneficial. The use of personality inventories such as the ZKPQ may be limited in clinical settings. Additional research should establish cutoff scores for suggested risk variables (eg, depressive scores) and identify measures that may be more readily available in clinical settings to assess neuroticism/anxiety and impulsive sensation-seeking traits. For instance, further research may examine the utility of the trait anxiety subscale of the State-Trait Anxiety Inventory[45] or the 4-item Brief Sensation Seeking Scale[46] for examining personality trait risk factors identified in the current study to be associated with risk of PMM.

Conclusions

In sum, the results of this study suggest that almost 18% of those with SCI with at least 1 painful condition who are prescribed pain medications report pain medication use behaviors suggestive of risk of aberrant use. Sociodemographic predictors were noted but somewhat differ from previous literature. Behavioral risk factors and psychological indicators provided additional explanation of risk of PMM. Being black, non-Hispanic, having greater perceived interference from pain, using prescribed pain medications daily, smoking cigarettes, recently using cannabis, having elevated impulsive and neurotic personality tendencies, and having depressed mood were indicators of heightened risk of PMM, assessed using the PMQ.

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