Published in final edited form as:

Addict Behav. 2020 October ; 109: 106467. doi:10.1016/j.addbeh.2020.106467.

MENTAL HEALTH, PAIN, AND RISK OF DRUG MISUSE: A NATIONWIDE COHORT STUDY

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Abstract

Evidence suggests that rising drug misuse, particularly of prescription painkillers, is more closely linked with period increases in reported pain among Americans of the same age range than with deterioration in mental health, but it is unclear whether those cross-sectional associations reflect causal effects of pain and mental health on drug misuse. Using data from the 1995-96, 2004-05, and 2013-14 waves of a nationwide cohort study, we evaluate the effects of pain and mental health on subsequent misuse of prescription painkillers and sedatives. Logistic regression is applied to model drug misuse (separately for painkillers and sedatives) as a function of predictors measured at the previous wave; respondents who reported misuse of that drug type at the prior wave are excluded from the analysis. Mental health is an important predictor of both painkiller and sedative misuse, whereas pain plays a much bigger role in painkiller misuse. Frequency of joint aches and stiffness has the strongest effect on subsequent painkiller misuse, although mental health yields substantial incremental predictive ability above and beyond pain. Negative affect, positive affect, and psychological well-being have notable effects on sedative misuse, while pain (particularly backache) makes only a small incremental contribution to sedative misuse. We suspect that increases over time in pain levels may have played a bigger role than mental health in explaining the rise in prescription painkiller misuse and may have contributed to growing misuse of sedatives. In contrast, deteriorating mental health was probably more important in explaining the rise of sedative misuse.

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CONTRIBUTORS

Dana A. Glei: Conceptualization, Methodology, Software, Data curation, Formal Analysis, Visualization, Writing-Original draft preparation, Writing-Reviewing and Editing. **Maxine Weinstein:** Conceptualization, Methodology, Supervision, Project Administration, Funding Acquisition, Writing-Reviewing and Editing.

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Declarations of interest: none

Data Statement: The MIDUS data used in this analysis are publicly available from the Inter-university Consortium for Political and Social Research (ICPSR, <https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/2760>; <https://www.icpsr.umich.edu/web/ICPSR/studies/4652>; <https://www.icpsr.umich.edu/web/ICPSR/studies/36346>).

CONFLICT OF INTEREST

Neither author declares a conflict of interest.

Keywords

Drug misuse; prescription painkillers; sedatives; pain; mental health; United States

1. INTRODUCTION

Drug-related mortality rose rapidly over recent decades in the US (Hedegaard et al., 2018). Prevalence of drug misuse (use of a substance for a purpose not consistent with legal or medical guidelines, World Health Organization, 2006) and abuse (misuse with potentially harmful consequences, Kaye et al., 2017) also increased, particularly among older Americans with low socioeconomic status (Glei et al., 2020; Glei & Weinstein, 2019). Analysis of national samples of Americans aged 25-74 in the mid-1990s and early 2010s suggested that the rise in drug misuse was more closely linked with increases in reported pain over the same period than with deterioration in mental health (Glei et al., 2020). Yet, the results varied by drug type. Mental health was more strongly associated with sedative misuse than with misuse of prescription painkillers. In contrast, pain was associated with both types of misuse, but pain explained more of the period differential in misuse of prescription painkillers (60%) than sedatives (38%). It is not clear the extent to which those cross-sectional associations reflect causal effects of pain and mental health on drug misuse.

While some cross-sectional studies have established an association between pain and prescription drug misuse (Blanco et al., 2013; Novak et al., 2009), we found only one prospective study that examined the effect of pain on subsequent drug misuse. Groenewald et al. (2019) demonstrated that chronic pain during adolescence was associated with subsequent prescription opioid misuse during adulthood, while depression and anxiety had no such effect. Another prospective study (Blanco et al., 2016) examined prescription opioid disorder (i.e., abuse or dependence as defined by DSM-IV criteria) rather than misuse. They reported that pain at baseline was associated with prescription opioid disorder three years later. We have not found any prospective studies that linked pain with use, misuse, or abuse of non-opioid drugs.

Several prospective studies have demonstrated that individuals with mental disorders have higher risk of prescription drug misuse than persons without such disorders (Katz et al., 2013; Martins et al., 2009; Martins et al., 2012; Morioka et al., 2018). One study found affective dysregulation, depressive symptoms, and psychological distress predicted incident misuse of prescription analgesics (i.e., misuse at the 3-year follow-up among those who reported at baseline that they had not previously misused a prescription analgesic in their lifetime), although none of those mental health measures was associated with incident misuse of other drugs (Morioka et al., 2018). In contrast, two other studies showed that the presence of a pre-existing mood disorder was linked with increased risk of incident drug use (Harrington et al., 2011) or illicit drug use (Swendsen et al., 2010). To our knowledge, no prospective study has investigated the effects of pain or mental health on sedative misuse.

Here, we use a prospective nationwide cohort study with 18 years of follow-up to evaluate the relative contributions of pain and mental health (both positive and negative dimensions) to subsequent misuse of prescription painkillers and sedatives. Given the reciprocal

relationship between pain and mental health, it is important to consider both influences. While many studies have investigated the effects of mental disorders on drug misuse (Katz et al., 2013; Martins et al., 2009; Martins et al., 2012; Morioka et al., 2018), few have examined well-being, which is not merely the polar opposite of distress but rather represents a distinct domain (Keyes, C. L., 2005; Ryff, C. D. et al., 2006). Because previous cross-sectional findings have shown that mental health was more strongly associated with misuse of sedatives than prescription painkillers (Glei et al., 2020), we anticipate mental health will be a stronger predictor of sedative misuse than painkiller misuse in this prospective study. In contrast, those earlier results demonstrated that pain was associated with both types of abuse, but accounted for more of the rise over time in misuse of painkillers than sedatives (Glei et al., 2020). Thus, we expect pain will have a substantial effect on both types of abuse, but will be especially important in predicting painkiller misuse.

2. MATERIALS AND METHODS

2.1 Data

We use longitudinal data from Waves T1 (1995-96), T2 (2004-05), and T3 (2013-14) of the Midlife in the United States (MIDUS) study. At T1 (fielded January 1995-September 1996), MIDUS conducted phone interviews with non-institutionalized, English-speaking adults aged 25-74 in the coterminous United States ([dataset] Brim et al., 2019). National random digit dialing with oversampling of older people and men was used to select the main sample ($N=3487$) and a sample of twin pairs ($N=1914$). The study also included a random subsample of siblings of individuals in the main sample ($N=950$) and oversamples from five metropolitan areas in the U.S. ($N=757$). The response rate for the phone interview ranged from 60% for the twin subsample to 70% for the main sample. Among those who completed the phone interview ($N=7108$), 6325 (89%) also completed a mail-in self-administered questionnaire ([dataset] Ryff, Almeida, Ayanian, Carr et al., 2017). At T2 (fielded January 2004-August 2005), the MIDUS cohort was re-contacted: $N=4963$ (75% of survivors) completed a follow-up telephone interview and $N=4041$ (81% of those who completed the phone interview) completed the self-administered questionnaire. Finally, the cohort was contacted again at T3 (fielded May 2013-June 2014); $N=3294$ (55% of survivors) completed the telephone interview and $N=2732$ (83% of those who completed the phone interview) completed the self-administered questionnaire ([dataset] Ryff, Almeida, Ayanian, Binkley et al., 2017).

Our analyses are restricted to the subsample of 3929 respondents who completed the self-administered questionnaire at both T1 and T2. Among the 6325 respondents who completed the self-administered questionnaire at wave T1, 423 died before T2, 1233 did not complete the T2 phone interview, and another 740 did not complete the T2 self-administered questionnaire. Among those who completed the self-administered questionnaire at both T1 and T2, another 400 died before T3, 689 did not complete the T3 phone interview, and another 315 did not complete the T3 self-administered questionnaire, leaving 2525 who completed the T3 self-administered questionnaire for the analyses of the period between T2 and T3.

MIDUS obtained written, informed consent from all participants and received human subjects approval from the institutional review board at the University of Wisconsin, Madison.

2.2 Measures

2.2.1 Drug Misuse—The respondent was asked whether, during the past 12 months, s/he used various types of drugs and medications (i.e., sedatives, tranquilizers, amphetamines, prescription painkillers, inhalants, marijuana/hashish, cocaine/crack/free base, hallucinogens, heroin, prescription anti-depressants) “on your own”—that is, “without a doctor’s prescription, in larger amounts than prescribed, or for a long period than prescribed” (see eText 1 for the detailed wording). These questions were based on the Composite International Diagnostic Interview (World Health Organization, 1990). Throughout the remainder of the paper we use the commonly used term “misuse” to refer to such drug usage (which is sometimes referred to as “nonmedical use”). Because few respondents reported use of sedatives (<4%) or tranquilizers (<3%) and because the terms are often used as synonyms, we combine them into one group, which we refer to as “sedatives.”

2.2.2 Mental health—We include six measures of mental health. The first two measures capture psychological distress: the CIDI-SF major depression scale (Kessler et al., 1998; Nelson et al., 2001) and the negative affect index (Kessler et al., 2002; National Comorbidity Survey, 2005). We also include two measures of hedonic well-being (i.e., happiness/pleasure): the positive affect index (Kessler et al., 2002; National Comorbidity Survey, 2005) and life satisfaction. Finally, two measures capture eudaimonic well-being (i.e., realization of one’s full potential (Ryan & Deci, 2001)): psychological (Ryff, Carol D., 1989) and social (Keyes, Corey L. M., 1998). The construction of these measures has been described elsewhere (Glei et al., 2020; Goldman et al., 2018).

2.2.3 Pain—We include two measures of pain. Respondents were asked how often they experienced lower backaches and aches/stiffness in joints during the past 30 days with responses coded on a six-point scale from “not at all” to “almost every day”.

2.2.4 Controls—Like many prior studies of drug use, misuse, or abuse, we control for the following potential confounders: age, sex, race/ethnicity, marital status, and a measure of relative socioeconomic status (SES), which has been described in detail elsewhere (Glei et al., 2018; Glei et al., 2019; Glei & Weinstein, 2019; Goldman et al., 2018).

2.3 Analytical Strategy

Standard practices of multiple imputation are used to handle missing data (Rubin, 1996; Schafer, 1999); see eText 2 for more details. Descriptive statistics for the predictor variables are provided in Table 1. We use logistic regression to model drug misuse at wave $t+1$ (i.e., T2, T3) as a function of predictors measured at wave t (i.e., T1, T2). We restrict the analysis sample to respondents who reported no drug misuse at prior wave(s) because of potential endogeneity (i.e., prior drug misuse could influence pain and mental health). We refer to the outcome as “subsequent drug use” because we cannot measure lifetime incidence (i.e., we can only exclude respondents who reported drug misuse during the 12 months prior to the

survey, but we cannot determine whether they ever misused drugs). Subsequent drug misuse at wave T2 is based on respondents who reported no drug misuse at T1; subsequent drug misuse at wave T3 is limited to respondents who reported no misuse at T1 or T2. We estimate these models separately for misuse of painkillers and sedatives because we expect the predictors to operate differently by drug type. We do not model misuse for cannabis or other drugs because there are few respondents who report subsequent misuse of those drugs (i.e., cannabis: N=47 at T2, N=33 at T3; other drugs: N=85 at T2, N=42 at T3; Table 2).

All models include the control variables, and we use a robust estimator of variance to correct for intra-family clustering. In Model 1, we test the two measures of psychological distress. Model 2 substitutes the two measures of hedonic well-being, while Model 3 substitutes the two measures of eudaimonic well-being. We also estimate an auxiliary Model 3b that includes all six mental health measures in order to evaluate their total contribution. Model 4 tests the two pain measures. Finally, in Model 5, we include all of the mental health and pain measures simultaneously. To facilitate comparisons of effect size, all of these measures are standardized.

To quantify the predictive ability of these measures, we use the Area Under the Receiver Operating Characteristic Curve (AUC), which is a commonly used measure of discrimination. The gain in the AUC is computed relative to the baseline model that includes only the control variables. An increase of 0.01 in the AUC is considered a meaningful improvement (Pencina et al., 2008).

In addition to our primary modeling strategy, as a sensitivity check, we use an alternative lagged dependent variable model to predict misuse of prescription pain killers and sedatives at wave $t+1$ controlling for misuse of that drug type at wave t . Implicitly, we are modeling change in drug misuse status between subsequent survey waves.

Finally, in order to assess how mortality and loss-to-follow-up may affect our results, we use multinomial logistic regression to fit auxiliary models to the full sample of respondents who completed the mail-in questionnaire at T1 ($N=6325$) and at T2 ($N=3929$). In these models, there are four possible outcomes at the subsequent survey wave (i.e., T2 and T3, respectively): no drug misuse, drug misuse, lost-to-follow-up, or death.

3. RESULTS

At baseline (T1, 1995-96), only a small minority of respondents (14%; Table 2) reported any drug misuse during the prior 12 months (hereafter referred to as “prior misusers”). The drugs most commonly misused were cannabis and painkillers (6% each), followed by sedatives (5%), and finally, all other drugs combined (3%). Among those who did not report any drug misuse at baseline, 8% reported misuse at T2 (2004-05); hereafter, we refer to this group as “subsequent misusers.” Subsequent misuse at T2 was highest for sedatives and painkillers (4% each) and lowest for cannabis (1%). Among those who did not report any drug misuse at T1 or T2, 7% reported subsequent misuse at T3 (2013-14); misuse at T3 was highest for sedatives (4%), followed by painkillers (3%), and lowest for cannabis and other drugs (<2% each).

Table 3 presents the results from logit models predicting subsequent misuse of prescription painkillers. The mental health measure with the biggest effect is social well-being (a measure of eudaimonic well-being, Model 3), while joint pain exhibits the strongest overall effect (Model 4). In terms of predictive ability, the pain measures perform better (AUC Gain=0.034) than the measures of psychological distress (AUC Gain=0.023) and hedonic well-being (AUC Gain=0.015), but only slightly better than eudaimonic well-being (AUC Gain=0.032; Figure 1). When all six measures of mental health and both measures of pain are included in the same model (Model 5), the combined gain in AUC (0.063) is much larger than the gain contributed by pain (0.034) alone, suggesting that mental health makes a sizeable incremental contribution.

Mental health appears to be even more important for predicting subsequent sedative misuse (Table 4). Negative affect (Model 1), positive affect (Model 2), and psychological well-being (Model 3) have stronger effects than either pain measure (Model 4). Nonetheless, frequency of lower backache exerts a sizeable effect on sedative misuse. Eudaimonic well-being (AUC gain=0.042) and psychological distress (AUC gain=0.040) yield the most predictive power (Figure 1). The combined gain in AUC (0.063) from mental health and pain is somewhat larger than the contribution of all six mental health measures (0.054). Mental health yields the most power in predicting sedative misuse, whereas pain, particularly lower backache, makes a small incremental contribution.

Among the control variables, relative SES is inversely associated with the risk of subsequent misuse of painkillers (Table 3) and sedatives (Table 4). Although there is no discernible difference between sexes in subsequent misuse of painkillers (Table 3), we find that men are less likely than women to exhibit subsequent sedative misuse (Table 4).

When we use an alternative lagged dependent variable modeling strategy, the pattern of the results is similar (eTables 1 & 2). The differences in the results between the two modeling strategies are not large and the relative contributions of different sets of predictors remain unchanged.

Finally, results from multinomial models that include mortality and loss-to-follow-up as outcomes indicate that negative affect and prior sedative misuse predict higher subsequent mortality, while life satisfaction and joint pain are associated with lower mortality (results not shown). Backaches and prior painkiller misuse are associated with higher loss-to-follow-up.

4. DISCUSSION

The finding that pain is a more powerful predictor of prescription painkiller misuse than sedative use is consistent with prior cross-sectional analysis (Glei et al., 2020) suggesting that pain may have played an important role in accounting for the increase over time in prescription painkiller misuse. Nonetheless, mental health yields substantial incremental predictive ability above and beyond pain, suggesting that it makes an independent contribution to painkiller misuse. Our analyses suggest that the association between mental health and prescription painkiller misuse is not merely a spurious result caused by the effects

of pain on both mental health and painkiller misuse, nor does mental health simply mediate the effects of pain on painkiller misuse. Both pain and mental health appear to be important predictors of prescription painkiller misuse.

In contrast, mental health is a much better predictor of sedative misuse than pain, which makes only a small incremental contribution to sedative misuse. Whereas painkiller misuse is more strongly linked with joint pain, sedative misuse appears to be more strongly associated with backache, which could reflect that fact that muscle relaxants (some of which are also sedatives) are often prescribed for lower backache.

Among the mental health measures, eudaimonic well-being performs better than hedonic well-being and at least as well as psychological distress at predicting drug misuse of both types. This finding appears to contradict the results of a previous paper, which suggested that among the mental health measures, psychological distress accounted for the largest share of the period rise in drug misuse, while hedonic well-being played a bigger role than eudaimonic well-being in explaining the increase (Glei et al., 2020).

To explain a period increase in drug misuse, a variable must not only affect drug misuse, but must also have changed over time in a way that is consistent with the rise in drug misuse. For example, psychological well-being may be a strong predictor of sedative misuse, but if the levels of psychological well-being do not change much over time then it cannot explain a period increase in sedative misuse. As shown in Glei et al. (2020), there was little change between the mid-1990s and early-2010s in the levels of eudaimonic well-being, whereas among those with low SES there was marked deterioration in psychological distress and hedonic well-being over the same time period. Thus, our current results combined with the results from that earlier study suggest that psychological distress and hedonic well-being may have played a bigger role than eudaimonic well-being in explaining the increase in sedative misuse between the mid-1990s and early-2010s.

Several studies have documented a period increase in pain levels among the US population (Case and Deaton 2017; Case and Deaton 2015; Freburger et al. 2009; Nahin et al. 2019; Zimmer and Zajacova 2018). Comparing samples of the same age range, Glei et al. (2020) demonstrated that the period increase in pain (independent of aging) was even greater than contemporaneous deterioration in mental health. The current study provides evidence that pain affects misuse of painkillers, and to a lesser extent sedatives. Together, this evidence suggests that increases in pain over time may have played a bigger role than mental health in explaining the concurrent increase in painkiller misuse and may have also contributed to increased misuse of sedatives. In light of these results, further research is needed to understand the period rise in reported pain.

There are several limitations to this study. First, our ability to model incidence is constrained because we do not know if the respondent ever misused drugs nor can we identify all misuse over the course of the study; we know only whether the respondents reported misuse during the 12 months prior to each of the two follow-up waves. Consequently, the numerator may omit some “new” cases of drug misuse, and the denominator may include some respondents who misused drug earlier in life.

Second, we have limited statistical power. In particular, we do not have sufficient power to investigate misuse of cannabis and other drugs such as heroin, synthetic opioids, and methamphetamine.

Third, our pain measures capture frequency, but not duration or severity of pain. Thus, we cannot evaluate the effects of chronic pain. Although we include only two types of pain (i.e., lower back, joint), previous literature suggests that those are the most prevalent types of pain at the population level (Johannes et al., 2010). Given our limited pain measures, we may understate the effect of pain on drug misuse.

Fourth, our analysis is limited to respondents who survive and participate in the next survey wave approximately 9 years later. As noted above, we find back pain and prior painkiller misuse associated with loss-to-follow-up, while selected measures of mental health and prior sedative misuse are associated with mortality. Consequently, the most vulnerable individuals may have died or been lost-to-follow-up before they could be reinterviewed, which could lead us to under-estimate the effects of mental health and pain on subsequent drug misuse.

Finally, although there are many factors that may affect drug misuse, we focus on only two demand-side factors: mental health and pain. However, supply-side factors (e.g., availability, prescribing practices) are also likely to influence the propensity to misuse drugs. Indeed, such factors may initiate the sequence of events that eventually leads to painkiller misuse. Prolonged opioid use can increase sensitivity to pain and desensitize the dopamine system to naturally rewarding experiences (Ballantyne & Mao, 2003; Volkow, Wang, Fowler, Tomasi, & Telang, 2011). The initial increase in dopamine levels caused by addictive drugs serves as positive reinforcement, thereby encouraging repeated use (Ross & Peselow, 2012). Repeated drug use over-activates the basal ganglia—which is key to the brain’s “reward circuit”—thereby decreasing sensitivity and reducing the ability to experience pleasure from anything other than the drug (National Institute on Drug Abuse, 2018b). Thus, it is possible that aggressive marketing and over-prescribing of opioids leads to opioid-induced hyperalgesia, which in turn amplifies pain perception and encourages misuse of painkillers. Under this scenario, pain may be a proximate determinant of misuse, but supply-side factors could represent the root cause. This issue also highlights the importance of longitudinal analysis, which allows us to exclude individuals who report misuse at baseline and examine the effect of pain and mental health on subsequent misuse, thus reducing the possibility of reverse-causality (i.e., drug misuse increases perception of pain and exacerbates mental distress).

One question worth exploring in future research is: what factors predict the transition from drug *misuse* to drug *abuse*? Given the relatively low percentage of the population reporting drug abuse (<10% among a national sample aged 25-74 in the early 2010s, Glei & Weinstein, 2019), investigation of the factors that influence the transition from misuse to abuse would require an exceptionally large sample.

With all the attention focused on prescription opioids, some might question whether sedative misuse really matters. Concomitant use of opioids and other central nervous system depressants (e.g., tranquilizers such as benzodiazepines, muscle relaxants) may increase the risk of overdose (U.S. Food and Drug Administration, 2016); in 2015, 23% of those who

died from an opioid overdose also tested positive for benzodiazepines (National Institute on Drug Abuse, 2018). In addition to the potential adverse effects on mortality, sedative misuse may also have social and economic consequences for the individual, their family, and their community.

5. CONCLUSIONS

Mental health is an important predictor of both painkiller and sedative misuse, whereas pain plays a much bigger role in painkiller misuse. We suspect that increased pain was more critical than mental health in the rise in painkiller misuse. Yet, increasing psychological distress and declining hedonic well-being may be more important in explaining increases in sedative misuse over this same period.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

FUNDING

This work was supported by the National Institute on Aging [grant numbers P01AG020166, U19AG05142] and the Graduate School of Arts and Sciences, Georgetown University.

ABBREVIATIONS

AUC	Area Under the Receiver Operating Characteristic Curve
CIDI-SF	Composite International Diagnostic Interview Short Form
MIDUS	Midlife in the United States study
SES	Socioeconomic Status

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HIGHLIGHTS

- Mental health is an important predictor of both painkiller and sedative misuse.
- Pain plays a much bigger role in painkiller misuse than sedative misuse.
- Joint pain has the strongest effect on subsequent painkiller misuse.
- Negative affect has the strongest independent effect on sedative misuse.

Figure 1. Gain in AUC attributable to mental health and pain measures for subsequent misuse of prescription painkillers and sedatives.

Note: The AUC is a commonly used measure of discrimination. The gain in AUC is based on comparison with a baseline model (0.59 for prescription painkiller misuse; 0.60 for sedative misuse) that includes only the control variables. Most of these values are based on the models shown in Tables 3 and 4 (Model 3b is not shown).

Table 1.

Descriptive statistics for predictors measured at T1 (1995-96) and T2 (2004-05)

	T1 (1995-96) ^a	T2 (2004-05) ^b
<u>Control variables</u>		
Male, ^c %	44.5	44.1
Completed years of age (20-84), ^d mean (SD)	47.4 (12.4)	55.7 (11.2)
Non-Latinx white, ^c %	91.6	92.2
Married or living with a partner, ^c %	75.3	76.3
Relative SES (1-100), ^{d,e} mean (SD)	53.7 (28.5)	53.6 (28.5)
<u>Mental health</u>		
Negative affect (−0.8-5.9), ^{d,f} mean (SD)	0.0 (1.0)	−0.07 (0.9)
CIDI-SF major depression(−0.4-3.4), ^{d,f} mean (SD)	0.0 (1.0)	−0.08 (0.9)
Life satisfaction (−5.1-1.4), ^{f,g} mean (SD)	0.0 (1.0)	0.07 (0.9)
Positive affect(−3.4-2.2), ^{d,f} mean (SD)	0.0 (1.0)	0.08 (0.9)
Psychological well-being(04.6-1.8), ^{d,f} mean (SD)	0.0 (1.0)	0.05 (1.0)
Social well-being(−3.8-2.5), ^{d,f} mean (SD)	0.0 (1.0)	0.21 (1.0)
<u>Pain</u>		
Lower backache (−0.8-2.4), ^{f,g} mean (SD)	0.0 (1.0)	0.26 (1.1)
Not at all, %	41.8	30.3
Once a month, %	22.5	23.1
Several times a month, %	14.9	17.6
Once a week, %	5.3	5.8
Several times a week, %	7.8	12.0
Almost every day, %	7.8	11.3
Joint aches/stiffness (−1.0-1.8), ^{f,g} mean (SD)	0.0 (1.0)	0.53 (1.0)
Not at all, %	39.7	15.6
Once a month, %	14.0	15.0
Several times a month, %	16.7	20.0
Once a week, %	4.8	7.3
Several times a week, %	11.5	18.4
Almost every day, %	13.3	23.8
N of respondents	3929	2525

^a Among the sample of respondents who completed the self-administered questionnaire at T1 and T2.^b Among the sample of respondents who completed the self-administered questionnaire at T1, T2, and T3.^c Dichotomous variable coded 1 for the specified group and 0 for the reference group.^d Measured at an interval level; the range of values is shown in parentheses.

^eSES is based on education, occupation, income, and assets, which is converted to a percentile denoting the respondents' rank within the distribution at the specified survey wave.

^fStandardized based on the distribution at T1.

^gMeasured at an ordinal level.

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Table 2.

Drug misuse at T1 (1995-96), T2 (2004-05), and T3 (2013-14)

	Any Drug	Prescription Painkillers ^a	Sedatives	Cannabis	Other Drugs ^b
Completed self-administered questionnaire at T1 (N=6325)					
Misused in 12 months prior to T1, N (%)	878 (13.9)	362 (5.7)	298 (4.7)	407 (6.4)	204 (3.2)
No misuse in 12 months prior to T1, N (%)	5447 (86.1)	5963 (94.3)	6027 (95.3)	5918 (93.6)	6121 (96.8)
Completed self-administered questionnaire at T1 and T2 (N=3929)					
Among those with no misuse at T1:	(N=3429)	(N=3725)	(N=3757)	(N=3710)	(N=3819)
Misused in 12 months prior to T2, N (%)	281 (8.2)	140 (3.8)	161 (4.3)	47 (1.3)	85 (2.2)
No misuse in 12 months prior to T2, N (%)	3148 (91.8)	3585 (96.2)	3595 (95.7)	3664 (98.7)	3734 (97.8)
Completed self-administered questionnaire at T1, T2, and T3 (N=2525)					
Among those with no misuse at T1 or T2:	(N=2039)	(N=2318)	(N=2321)	(N=2349)	(N=2413)
Misused in 12 months prior to T3, N (%)	150 (7.4)	75 (3.2)	89 (3.8)	33 (1.4)	42 (1.7)
No misuse in 12 months prior to T3, N (%)	1888 (92.6)	2243 (96.8)	2232 (95.2)	2316 (98.6)	2371 (98.3)

Note: The questions refer to drug misuse in the 12 months prior to the survey.

^aThe question includes the following clarification, "[NOTE: This does not include normal use of aspirin, Tylenol without codeine, etc, but does include use of Tylenol with codeine and other prescribed painkillers like Demerol, Darvon, and Percodan]."

^bFor each of the following drug types, there are fewer than 20 respondents reporting misuse at T1 or T3 or both, therefore we have combined these drug types into the "other drugs" category: prescription anti-depressants, cocaine/crack/free base, amphetamines and other stimulants, heroin, hallucinogens, inhalants.

Table 3.

Odds ratios (and 95% confidence intervals) from logit models predicting subsequent prescription painkiller misuse among those who did not report prescription painkiller misuse at prior waves^a

Predictor	(1)	(2)	(3)	(4)	(5)
Male	0.95 (0.712 - 1.255)	0.90 (0.676 - 1.190)	0.89 (0.671 - 1.181)	0.92 (0.692 - 1.215)	0.92 (0.692 - 1.223)
Age - 40	0.99 (0.980 - 1.004)	0.99 (0.980 - 1.003)	0.99 (0.979 - 1.003)	0.98 (0.970 - 0.994)	0.99 (0.973 - 0.998)
Non-Latinx white	0.73 (0.467 - 1.137)	0.70 (0.452 - 1.093)	0.71 (0.459 - 1.114)	0.69 (0.445 - 1.072)	0.71 (0.456 - 1.108)
Married/partnered	1.22 (0.865 - 1.710)	1.23 (0.866 - 1.743)	1.18 (0.840 - 1.661)	1.11 (0.795 - 1.561)	1.19 (0.835 - 1.686)
Relative SES ^b	0.99 (0.985 - 0.996)	0.99 (0.985 - 0.996)	0.99 (0.987 - 0.998)	0.99 (0.986 - 0.996)	0.99 (0.988 - 1.000)
Negative affect ^c	1.15 (0.995 - 1.323)				1.01 (0.837 - 1.222)
CIDI-SF major depression	1.14 (0.989 - 1.314)				1.13 (0.977 - 1.308)
Life satisfaction ^c		0.87 (0.731 - 1.031)			0.96 (0.809 - 1.150)
Positive affect ^c		0.94 (0.784 - 1.133)			1.15 (0.902 - 1.458)
Psychological well-being ^c			0.86 (0.741 - 1.006)		0.88 (0.726 - 1.061)
Social well-being ^c			0.82 (0.698 - 0.963)		0.83 (0.708 - 0.985)
Lower backache ^c				1.11 (0.968 - 1.272)	1.08 (0.939 - 1.242)
Joint aches/stiffness ^c				1.28 (1.109 - 1.481)	1.25 (1.074 - 1.447)

^aThe analysis sample includes 3725 respondents from T1 who reported no prescription painkiller misuse during the prior 12 months prior to T1 and 2318 respondents from T2 who reported no prescription painkiller misuse at T1 or T2 (Table 2).

^bThis interval level measure ranges from 1 (bottom percentile) to 100 (top percentile). Thus, the coefficient represents the effect of a one percentile difference in rank.

^cAll mental health and pain measures are standardized (mean=0, SD=1 at T1) in order to compare effect size.

Odds ratios (and 95% confidence intervals) from logit models predicting subsequent sedative misuse among those who did not report sedative misuse at prior waves^a

Table 4.

Predictor	(1)	(2)	(3)	(4)	(5)
Male	0.66 (0.504 - 0.877)	0.64 (0.490 - 0.845)	0.62 (0.468 - 0.810)	0.64 (0.485 - 0.839)	0.66 (0.503 - 0.876)
Age - 40	1.01 (0.995 - 1.015)	1.00 (0.994 - 1.014)	1.00 (0.993 - 1.013)	1.00 (0.990 - 1.011)	1.01 (0.995 - 1.017)
Non-Latinx white	0.86 (0.545 - 1.360)	0.81 (0.513 - 1.264)	0.83 (0.527 - 1.306)	0.83 (0.528 - 1.302)	0.85 (0.536 - 1.336)
Married/partnered	1.23 (0.902 - 1.676)	1.18 (0.870 - 1.615)	1.20 (0.880 - 1.628)	1.11 (0.817 - 1.519)	1.19 (0.872 - 1.628)
Relative SES ^b	0.99 (0.989 - 0.999)	0.99 (0.988 - 0.998)	1.00 (0.991 - 1.001)	0.99 (0.989 - 0.998)	1.00 (0.991 - 1.001)
Negative affect ^c	1.39 (1.233 - 1.567)				1.21 (1.029 - 1.416)
CIDI-SF major depression	1.03 (0.906 - 1.179)				1.03 (0.902 - 1.171)
Life satisfaction ^c		1.08 (0.913 - 1.280)			1.19 (0.998 - 1.424)
Positive affect ^c		0.69 (0.586 - 0.802)			0.85 (0.699 - 1.023)
Psychological well-being ^c			0.76 (0.653 - 0.883)		0.85 (0.705 - 1.027)
Social well-being ^c			0.90 (0.767 - 1.065)		0.94 (0.794 - 1.101)
Lower backache ^c				1.25 (1.086 - 1.427)	1.18 (1.023 - 1.350)
Joint aches/stiffness ^c				0.98 (0.851 - 1.140)	0.91 (0.788 - 1.058)

^aThe analysis sample includes 3757 respondents from T1 who reported no sedative misuse during the prior 12 months prior to T1 and 2321 respondents from T2 who reported no sedative misuse at T1 or T2 (Table 2).

^bRanges from 1 (bottom percentile) to 100 (top percentile) so that the coefficient represents the effect of a one percentile difference in rank.

^cAll mental health and pain measures are standardized (mean=0, SD=1 at T1) in order to compare effect size.