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Prescription opioid use and employment: A nationwide Finnish register study

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ABSTRACT

Background: The secular decline in labor market participation and the concurrent increase in opioid use in many developed countries have sparked a policy debate on the possible connection between these two trends. We examined whether the use of prescription opioids was connected to labor market outcomes relating to participation, employment and unemployment among the Finnish population.
Methods: The working-age population (aged 19–64 years) living in Finland during the period 1995–2016 was used in the analyses (consisting of 67 903 701 person-year observations). Lagged values of prescription opioid use per capita were used as the exposure. Instrumental variables (IV) estimation method was used to identify causal effects, where opioid use per capita for the elderly (65–95-year-old) was used as an instrument for the opioid use per capita for the working-age population of the same gender, education and region.
Results: Increased opioid use led to worse labor market outcomes in the long run, with the effect size of 16 % and 20 %, compared to the standard deviation of the employment and participation rates. On the contrary, in the short run, increased opioid use had positive employment effects.
Conclusions: Policymakers should take the contradictory short- and long-term effects into account while considering regulation and monitoring of opioid use. Regulating and monitoring long-term prescription opioids is crucial for reducing their negative labor market consequences.

1. Introduction

Ensuring high labor market participation is a growing policy concern, as the participation rate has declined in many industrialized countries. For example, in the US, the participation rate of 25–54-year-old men with only a high school degree has dropped from 90 % in the late 1990s to 85 % in 2015 (Binder and Bound, 2019). Employment prospects of low-educated workers have also decreased in some EU countries. For example, their employment rate decreased in Finland from 60 % in 2000 to 53 % in 2017 (OECD, 2021a). At the same time, the use of prescription opioids has increased substantially and reached epidemic proportions (Guy et al., 2017), becoming a major public health concern, outside the US in other OECD countries too (Schepis and McCabe, 2016; Schuchat et al., 2017). These two trends have sparked a policy debate on the possible connection between the increased use of prescription opioids and the secular decline in labor force participation (Maclean et al., 2020).

A substantial body of research argues that economic and psychological distress (including prolonged unemployment) is positively associated with opioid use, without making explicit claims about the direction of causality. Evidence from the US shows that opioid use along with related morbidity and mortality (popularly known as "deaths of despair"), are strongly concentrated among those who have faced economic and psychological distress (Case and Deaton, 2017; Krueger, 2017; Ruhm, 2019). This pattern tends to apply to other industrialized countries as well (Nowakowska et al., 2021). For example, prescription opioid use in Finland (a Nordic welfare state) is more common among low socioeconomic status individuals (Böckerman et al., 2021). In

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addition to descriptive evidence documenting associations, there is past literature establishing a causal effect between unemployment and opioid use. For example, plant closures in the US automobile industry have led to increased opioid use among the affected workers (Venkataramani et al., 2020), while an increase in the unemployment rate has been linked with increased consumption of opioids in the UK (Vandoros et al., 2021).

There is more limited evidence on the effect of opioid use on employment outcomes (Harris et al., 2020; Park and Powell, 2021). In the US, those who are out of the labor force commonly suffer from serious and chronic health problems and use pain medication such as prescription opioids frequently (Krueger, 2017). Empirical studies have also provided evidence of the connection between the use of prescription opioids and low labor force participation, using county-level data in the US context (Harris et al., 2020), but there is also ambiguous evidence on the link (Currie et al., 2019). While the use of opioids has increased in many European countries too (Bosetti et al., 2019; Kalkman et al., 2019), the findings have been mixed, with both positive (Davies et al., 2019; Mordecai et al., 2018) and negative results (Persmark et al., 2019). In brief, the evidence is far from conclusive to draw policy implications and cannot necessarily be interpreted as causal. In addition, there is little credible evidence on the causal link between the increased use of prescription opioids and the declining labor force participation outside the US.

Moreover, the effect of increased opioid use on employment outcomes may differ in the short run *vis-a-vis* the long run. Based on the earlier literature and policy debate, we hypothesized that it is plausible for increased opioid use to improve labor market outcomes (employment) in the short run. The main reason for this is that serious chronic pain such as lower back pain and other musculoskeletal conditions are associated with an increased risk of withdrawal from the labor market (Dorner et al., 2015; Lallukka et al., 2020; Piper et al., 2021). Notably, there is evidence from the US that among women, the increased use of prescription opioids has improved their labor market participation, by enabling them to cope with serious and chronic pain while being employed (Currie et al., 2019). In contrast, the negative effects of increased opioid use are likely to be more pronounced in the long run, as opioids are not very effective for non-cancer pain management (Busse et al., 2018), and their prolonged use can lead to abusive consumption and addiction (Højsted and Sjøgren, 2007). This in turn can harm both physical and mental health, leading to lower levels of employment and a higher probability of becoming unemployed (Böckerman and Ilmakunnas, 2009). It is also conceivable that an important life-course event, such as a job loss, which has been shown to lead to opioid use (Venkataramani et al., 2020), may further lead to transition out of the labor force in the long run, through abusive opioid usage.

In the present study, using the nationwide population-based register data, we examined whether the use of prescription opioids is connected to labor market participation and other closely related labor market outcomes (employment and unemployment) among the working-age population in Finland during the periods 1995–2008 and 2009–2016. Our analysis studied the effects both in the short and long runs. To tease out causal links, we estimated instrumental variable (IV) models. The Finnish context is relevant and of wider interest for several reasons. First, there is only limited evidence from Europe with an explicit focus on the potential causal effect of opioid use on employment outcomes. Finland is a rich industrialized country of Northern Europe, with universal health care access and a robust social security system. Second, the share of prescription opioid users increased in Finland from less than 2% to 7% between 2000 and 2010, and is similar to the trends in other European countries (Böckerman et al., 2021). In addition, the availability of prescription analgesic opioids in Finland is quite close to the OECD average (OECD, 2019). Third, there has been a decline in labor force participation in Finland among the 25–34 age group (from 85 % to 82 % between 2000 and 2017), reflecting the labor market trends in other countries (e.g., US, Belgium, and Denmark; see OECD, 2021b).

2. Methods

2.1. Study population

The present study data were formed by linking the prescription register (PR) to the nationwide register of Statistics Finland, which contains individual-level demographics and socioeconomic characteristics. The registers cover the period 1995–2016 and were linked using personal identification codes. The present study data contains all the individuals living in Finland during 1995–2016 (i.e., 67 903 701 person-year observations).

PR by the Social Insurance Institution contains filled opioid-related prescriptions dispensed at Finnish pharmacies. Opioids cover the WHO's Anatomical Therapeutic Chemical (ATC) Classification System codes beginning with "N02A" (strong analgesics of the opiate type and analgesics with similar structure or action). The data contained patient-level prescriptions reimbursed under the National Health Insurance (NHI) scheme. Individuals may have obtained reimbursement of opioid prescriptions several times in the same year.

2.2. Exposure

Opioid use was measured using Defined Daily Dose (DDD), which provides a fixed unit of measurement accounting for the differences in package size and strength, enabling comparisons between population groups. Opioid use was aggregated by gender, age, education and region cells separately for the working-age population (19–64-year-old) and elderly population (65–95-year-old). Per capita usage was obtained by dividing by the population in the respective cell.

2.3. Outcomes

The labor status of every individual was measured during the last week of each calendar year, using register-based information on whether he or she participated in the labor force, and more specifically, whether the participating individual was employed or unemployed. The analysis of labor market outcomes was restricted to the working-age population aged between 19 and 64. Finally, the data were aggregated by gender, age (19–24, 25–44 and 45–64) and education groups (compulsory, secondary, tertiary) in each of the 108 regions (local labor market area, i.e., LMAs) officially defined by Statistics Finland, by using commuting flows (but some single-municipality LMAs were further aggregated).

For each aggregated cell, outcome measures were defined as follows: employment rate was calculated as the ratio of 19 to 64-year-old employed people to the population of the same age; the unemployment rate was the ratio of the unemployed to the labor force (i.e., the sum of employed and unemployed people) among 19 to 64-year-olds; finally, the participation rate was the ratio of 19 to 64-year-old employed and unemployed people to the population of the same age.

2.4. Statistical methods

Our aim was to examine the potential effect of opioid use on the likelihood of participation in the labor market and on the labor market status of participants. Using aggregated cell data, we investigated whether the higher prescription of opioids in a region leads to lower participation and employment rates or higher unemployment rate in that region, while accounting for other key determinants of labor market outcomes. It is also possible that there is a reverse effect, e.g., psychological distress associated with unemployment, making it more likely for people to need prescription opioids. There may also be unobserved confounding factors such as the average health status of people in the region that simultaneously increase opioid use and affect labor market outcomes.

To avoid concurrent reverse causality, we used lagged values of

prescription opioid use per capita as the exposure. This amount to assuming that past opioid use affects labor market outcomes. To address residual confounders and identify causal effects, we used the instrumental variables (IV) estimation method (Angrist et al., 1996), where the opioid use per capita for the elderly (65–95-year-olds) was used as an instrument for the opioid use per capita for the working-age population of the same gender, education and region, as in a recently published study (Currie et al., 2019). In contrast to Currie et al. (2019), our instrument varies by education level also, whereas it varies only by gender and region in Currie et al. (2019).

The relevance of the instrument is based on the assumption that patients in different regions have different access to prescription opioids (among both the elderly and working-age population). Local labor market conditions do not have a direct impact on the opioid use of the elderly, because they are not in the labor force. The identifying assumption for the validity of the instrument is that the access to prescription opioids is determined exogenously with respect to the labor market outcomes of the regions. This exogeneity assumption is likely to hold for the Finnish universal health care system because the system is fragmented and health services are provided at the local level. Our IV approach based on exogenous instrument variable (i.e., opioid use per capita for the elderly) and fixed effects for local labor market areas address potential ecological fallacy concerns in aggregate data. Alternative IV approach would be to estimate the effects at the individual level, using identifiers for physicians that would allow linking opioid use for the individual and the elderly population. However, our data do not have identifiers for physicians. Therefore, we used aggregate data on access to prescription opioids as the instrument.

All regressions included fixed effects for gender, age groups (19–24, 25–44 and 45–64) and education groups (compulsory, secondary, tertiary) as controls for the permanent differences in labor market outcomes between these groups that are not related to opioid use. The time effects were included to capture common nationwide trends such as macroeconomic fluctuations for all regions in the labor market outcomes, as well as in the usage of opioids.

Lastly, we examined separately the effects over the short and long run. The short-run causal effect of opioid usage on the labor market outcomes is estimated with annual data over the period 1995–2008. The short-run models include indicators for the local labor market areas (LMAs). Regressions also control for gender, age groups and education groups, as mentioned above. The variable of interest is the opioid use per capita in the working-age population, which is instrumented with the opioid usage in the over 65-year-old population. As the model estimates the effect of previous year opioid use on the labor market status next year, we consider this as a short-run effect.

To estimate the long-run causal effect of opioid usage on the labor market outcomes, we used long-differences data over the 13 years 1995–2008. As this estimation provides the relationship between a sustained long-term change in opioid use and the long-term change in labor market status, we consider it to identify the long-run effect of opioid usage. Taking a difference eliminates the region-specific fixed effects from the estimation, thereby removing any correlation arising from the confounding permanent region-specific effects. Inference based on differences is potentially affected by attenuation bias from the measurement error. This bias is reduced in our estimations using long differences, since the noise-to-signal ratio due to measurement error is smaller in long differences, compared to short differences (Griliches and Hausman, 1986). Further, we instrumented the 13-year change in opioid usage of the working-age population with the 13-year change in opioid usage by the over 65-year-old population, as well as with the initial year (1995) level of this variable. This approach further addresses the bias stemming from measurement error, as well as other potential sources of endogeneity.

3. Results

3.1. Study characteristics

Descriptive statistics for the full sample, by gender, age and education groups, are shown in Table 1. Significant variation was found both in opioid use and labor market outcomes, as indicated by the standard deviations. For example, the average annual DDD per capita was substantially lower for tertiary-educated individuals (0.543) than for those with compulsory education alone (1.400). A contrary pattern was observed for their labor force participation rate (0.881 vs. 0.659). There was also substantial regional variation within each group, which is useful for the identification of the effects.

3.2. Ordinary Least Squares (OLS) analyses

OLS results with and without local labor market area (LMA) fixed effects for the whole population of Finnish working-age individuals are shown in Table 2. In the estimations without the LMA effects (see columns 1, 3 and 5 in Table 2), the coefficients for opioid usage indicated a strong correlation with negative labor market outcomes, with lower employment and participation rates and higher unemployment rate when opioid usage was high. All specifications included fixed effects for gender, age and education groups; thus, the correlation arises essentially from variation across regions (LMAs) in opioid use and labor market outcomes. In the estimations with the LMA effects (see columns 2, 4 and 6 in Table 2), the coefficients for opioid use diminish considerably, while remaining significant for employment and participation, but not for unemployment. The LMA fixed effects account for permanent, constant differences over time among regions; thus, the estimates for these effects of opioid usage arise essentially from its correlation with labor market outcomes over time within LMAs. Taken together, the results in Table 2 indicate that the correlation of opioid usage and labor market outcomes is to a large extent due to permanent or long-term differences between regions, and to a smaller extent to short-run time variation in these variables over time.

3.3. Instrumental variable analyses

The results from the instrumental variables estimation are shown in Table 3. The (partial) F-tests for the instrument variable(s) in the first stage regression show that there is no indication of a weak instrument problem in any of the estimated models, i.e., values of these statistics are above the Staiger and Stock rule of thumb value of 10 (Staiger and Stock, 1997). The estimated effects in columns 1 and 5 of Table 3 indicate that opioid usage has a short-term positive causal effect on labor market participation and employment within LMAs (p-values < 0.05). The effect of long-term *changes* in instrumented opioid usage on long-term *changes* in labor market outcomes were negative for employment and participation rates (p-values < 0.01; see columns 2 and 6 in Table 3), indicating that long-term increases in opioid use led to a long-term decline in labor market outcomes.

The effect of opioid use on labor market outcomes was found to be economically significant. Using interquartile range (IQR) for the opioid usage per capita (0.91) and the long-run coefficients in Table 3, the predicted difference between regions in the upper and lower quartiles was -2.5 percentage points in both the employment rate and the participation rate. Using the means of these variables from Table 1 shows that these effects were respectively 3.7 % and -3.2 % of the mean values. Alternatively, the effects were 16 % and 20 % compared to the standard deviation of employment and participation rates. Using the standard deviation of opioid usage (1.33) instead of IQR would produce quantitatively about 45 % larger differences in outcomes.

To illustrate the quantitative magnitude of the estimated effects further, Fig. 1 presents the observed development of the employment rate for 1996–2008, and the contribution thereto of increased opioid

Table 1
Mean values by sample.

	19–64-year-olds				65–95-year-olds
Sample	Employment rate	Unemployment rate	Participation rate	Opioid DDD per capita	Opioid DDD per capita
Full sample	0.678	0.134	0.776	0.879	2.723
N = 41,853,033	(0.153)	(0.081)	(0.127)	(0.933)	(1.677)
Gender					
Male	0.688	0.137	0.790	0.972	2.746
N = 21,132, 967	(0.155)	(0.081)	(0.129)	(1.010)	(1.647)
Female	0.668	0.131	0.761	0.784	2.701
N = 20,720, 066	(0.151)	(0.082)	(0.123)	(0.835)	(1.707)
Age group					
19–24 years	0.482	0.176	0.577	0.136	2.793
N = 5,092,915	(0.127)	(0.109)	(0.100)	(0.387)	(1.623)
25–44 years	0.772	0.114	0.868	0.529	2.568
N = 18,243,019	(0.110)	(0.075)	(0.066)	(0.680)	(1.702)
45–64 years	0.639	0.143	0.739	1.428	2.857
N = 18,517 099	(0.126)	(0.072)	(0.095)	(0.946)	(1.654)
Level of education					
Compulsory	0.522	0.210	0.659	1.400	3.515
N = 10,902, 684	(0.100)	(0.070)	(0.104)	(1.178)	(1.082)
Upper-secondary	0.672	0.137	0.775	0.794	2.638
N = 18,767, 839	(0.124)	(0.067)	(0.115)	(0.829)	(1.721)
Tertiary	0.827	0.062	0.881	0.543	2.146
N = 12,182, 510	(0.063)	(0.034)	(0.048)	(0.566)	(1.774)

Notes: Standard deviations are in parentheses below the mean values. N = Number of person-year observations. Full sample includes annual observations from population aged between 19 and 64 from the period 1995–2008. Defined daily dose (DDD) is defined according to the World Health Organization as the assumed average maintenance dose per day for a drug used for its main indication in adults.

Table 2
The effect of opioid usage on labor market outcomes: OLS estimation with and without fixed effects for LMAs (1995–2008).

Variables	(1) Employment rate	(2) Employment rate	(3) Unemployment rate	(4) Unemployment rate	(5) Participation rate	(6) Participation rate
Opioid use per capita	−0.0228***	−0.0088***	0.0145***	0.0024***	−0.0138***	−0.0075***
	(0.0015)	(0.0010)	(0.0012)	(0.0008)	(0.0010)	(0.0009)
Constant	0.3185***	0.3609***	0.2987***	0.2597***	0.4879***	0.5050***
	(0.0057)	(0.0053)	(0.0054)	(0.0042)	(0.0045)	(0.0052)
Observations	25,091	25,091	25,091	25,091	25,091	25,091
R^2	0.843	0.918	0.596	0.808	0.870	0.894
FEs for LMAs	No	Yes	No	Yes	No	Yes
Mean of dependent variable	0.621	0.621	0.164	0.164	0.731	0.731
Model F-test statistics	1138	478.9	392.6	287.4	1500	282.5

Notes: Robust standard errors in parentheses: *** $p < 0.01$. All regressions include fixed effects (FEs) for gender, age groups (19–24, 25–44 and 45–64) and education groups (compulsory, secondary, tertiary). LMA refers to local labor market area. Weighted by working-age population.

Table 3
The effect of opioid usage on labor market outcomes: IV estimation with fixed effects for LMAs (1995–2008).

Variables	(1) Employment rate	(2) Change in employment rate	(3) Unemployment rate	(4) Change in unemployment rate	(5) Participation rate	(6) Change in participation rate
Opioid use per capita	0.0578**	−0.0270***	−0.0103	0.0041	0.0454**	−0.0271***
	(0.0275)	(0.0082)	(0.0156)	(0.0066)	(0.0231)	(0.0079)
Constant	0.3944***	0.2151***	0.1737***	−0.2723***	0.4819***	0.0737***
	(0.0252)	(0.0150)	(0.0147)	(0.0125)	(0.0212)	(0.0178)
Observations	25,091	1916	25,091	1916	25,091	1916
R^2	0.866	0.632	0.801	0.793	0.846	0.439
FEs for LMAs	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dependent variable	0.621	0.108	0.164	−0.131	0.731	0.0238
First-stage F-test statistics	16.40	13.39	16.40	13.39	16.40	13.39

Notes: Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$. All regressions include fixed effects (FEs) for gender, age groups (19–24, 25–44 and 45–64) and education groups (compulsory, secondary, tertiary). All equations also account for fixed effects for local labor market areas (LMAs). Short-run models in columns (1), (3) and (5) include a full set of LMA indicators, and long-run models in columns (2), (4) and (6) difference out these fixed effects. In models (2, 4 and 6), the independent variable is the change in opioid use per capita over 1995–2008. Weighted by working-age population.

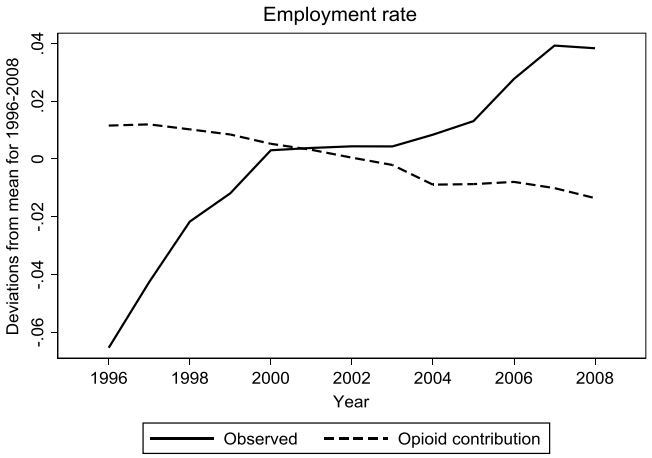

Fig. 1. The contribution of increased opioid usage to the development of employment rate, 1996–2008.
Notes: The figure reports the observed development in the employment rate and the contribution of increased opioid usage to the employment rate. The contribution of opioid usage to the employment rate is calculated using the long-run coefficient estimates from column (2) in Table 3. The figure shows that the employment rate would have increased 2.5 percentage points more without the increased opioid usage over the period 1996–2008.

usage, using the long-run coefficient from column (2) in Table 3. Based on this back-of-envelope calculation, the employment rate increased by approximately 10 percentage points over this period, but it would have increased by 2.5 percentage points more, without the increased opioid usage over the same period. The employment rate thus grew by one-fifth less due to the increased opioid usage than without it, over the 13 years 1996–2008.

To complete the analysis, in Table 4, we examined the effects using annual data for the longer period 1995–2016, taking into account the break in the opioid series (caused by the inclusion of codeine-based opioids to the list of reimbursed medicines covered by NHI in 2008). That is, we included as an additional variable, the interaction of opioid usage with a step-dummy for the period 2010–2016 (D [2010–2016] is 1 for the years 2010–2016, and 0 for all other years). The interaction term was instrumented with the lagged opioid usage for the elderly interacted with the step-dummy. The coefficient for this variable indicates whether and how much the opioid effect for the years 2010–2016 differs from the effect for 1995–2009, which is obtained as the coefficient for opioid usage.

Table 4
The effect of opioid usage on labor market outcomes: IV with fixed effects for LMA (1995–2016).

Variables	(1) Employment rate	(2) Unemployment rate	(3) Participation rate
Opioid use per capita	0.0834***	−0.0433***	0.0568***
	(0.0169)	(0.0102)	(0.0129)
Opioid use per capita ×D[2010–2016]	−0.0749***	0.0369***	−0.0539***
	(0.0142)	(0.0086)	(0.0108)
Opioid use effect 2010–2016	0.008	−0.006	0.003
Wald test Chi-squared	8.02***	12.4***	1.46
p-value	(p = 0.005)	(p = 0.0004)	(p = 0.23)
Observations	40,422	40,422	40,422
R^2	0.820	0.709	0.824
FEs for LMAs	Yes	Yes	Yes
Mean of dependent variable	0.624	0.161	0.733
First-stage F-test statistics (F1)	513.4	513.4	513.4
First-stage F-test statistics (F2)	565.4	565.4	565.4

Notes: Robust standard errors in parentheses: *** p < 0.01. All regressions include fixed effects (FEs) for gender, age groups (19–24, 25–44, 45–64) and education groups (compulsory, secondary, tertiary). All equations also control for fixed effects for LMAs (local labor market areas). Weighted by working-age population. The null hypothesis in the Wald test is that the opioid effect is zero in the 2010–2016 period, i.e., the sum of coefficients for opioid usage and its interaction with the step-dummy is zero. First-stage F-test statistics (F1) is for the opioid usage and first-stage F-test statistics (F2) is for its interaction with the step-dummy.

The results in Table 4 confirmed significant positive employment and participation effects, as in our main results in Table 3 for the period 1995–2008. However, the coefficients for the interaction terms in each column were of the opposite sign and almost as large as the main effects. Therefore, the positive short-run employment effects were considerably reduced (to about one-tenth) during 2010–2016, although they remained statistically significant, except for the participation rate, according to the Wald tests in Table 4. It is to be noted that the first period in these results included 2009, whereas our main results did not, to safeguard against any effects from the global financial crisis confounding our main estimation results.

4. Discussion

In the present study, we investigated the effect of prescription opioid use on labor market participation, employment and unemployment, using the nationwide working-age population data from Finland. We found that increased opioid use led to worse labor market outcomes in the long run, with an effect size of 16 % and 20 %, compared to the standard deviation of the employment and participation rates. On the contrary, we observed that in the short run, increased opioid use led to improved labor market participation and employment between 1995 and 2008. Between 2009 and 2016, the effect was quantitatively small.

The present study contributed to the sparse literature that examines the link between opioid use and labor market outcomes using the instrumental variable estimation method. Although previous studies have provided evidence of an association between the use of prescription opioids and labor force participation in the US (Currie et al., 2019; Harris et al., 2020), findings from other countries have been mixed (Davies et al., 2019; Mordecai et al., 2018; Persmark et al., 2019). However, earlier studies have mostly used research designs based on non-causal inference and thus the results cannot necessarily be interpreted as causal effects. For example, regional variation in health could be related to both opioid use and poor labor market outcomes. Further, regional differences in the sectoral structure of the economy may affect employment and unemployment levels that could further lead to different opioid usage in the region.

Our results, using the instrumental variable estimation method, suggested that the association is causal, i.e., increased opioid use decreases labor market participation and employment substantially in the long run. This long-term finding is consistent with the standard equilibrium unemployment models, as opioid usage affects the supply of labor (i.e., participation) negatively, and this supply effect is manifested as a lower employment rate, rather than a higher unemployment rate (Layard et al., 2005).

The finding that this effect is likely to be reverse in the short run, could partially explain the mixed findings in the earlier literature (Davies et al., 2019; Mordecai et al., 2018; Persmark et al., 2019). This pattern is consistent with past evidence, according to which the use of pain medication may support labor market participation (Currie et al., 2019). That is, as opioids provide relief from chronic pain, e.g., lower back pain and other musculoskeletal conditions, they facilitate participation in the labor market and employment, rather than withdrawal from employment due to incapacitating chronic pain. However, in our data, the positive short-run employment effects were considerably

smaller from 2010 to 2016. We can exclude the demographic shifts as the explanation for this pattern, because there have not been major changes in the composition of individuals who use prescription opioids between the periods (Böckerman et al., 2021). This leaves three plausible explanations for the finding. First, the use of prescription opioids has increased over time that may have pushed more individuals with no meaningful health benefits (i.e., chronic pain relief) to use opioids. This potentially dilutes the positive short-run employment effects. Second, the duration that individuals have used prescription opioids may be a factor that explains the finding. It is possible that some individuals started to use opioids in the 1990s or early 2000s and thus the short-run effects in the second period may be long-run effects of the first period. However, the Finnish health care system does not promote long-term use of opioids. Third, the prolonged effects of the financial and euro crises on employment in Finland may have confounded the effects of opioid usage for the period 2009–2016. The financial crisis had its major effect on employment in Finland from 2009. The euro crisis led to lagging employment until 2016, with some ups and downs in labor market indicators around 2012.

There are several mechanisms, not directly examined here, which could explain why increased opioid use decreases labor market participation and employment substantially in the long run. First, opioids are not very effective in managing non-cancer pain (Busse et al., 2018), and are thus not likely to help those coping with chronic pain to continue working or getting a job. Second, long-term opioid use can lead to opioid addiction (Højsted and Sjøgren, 2007), which is a chronic disorder characterized by frequent relapses and elevated morbidity and mortality (Hser et al., 2015; Strang et al., 2020). Opioid use also has high comorbidity with other mental disorders (Quinn et al., 2019) associated with low employment rate in the long run (Hakulinen et al., 2019). Lastly, life-course research suggests that there are several important factors, such as social ties with family members, which in the first place predict whether an individual commences and continues the use of opioids (Hser et al., 2007).

The economic aspects of the opioid epidemic have attracted growing interest in recent years (Maclean et al., 2020). The present findings provide an important addition to this literature and thus have potential policy implications. The main implication is that policymakers should consider both the positive short-run and negative long-term effects of opioid use on labor market participation and employment. Striking a balance between these contrary effects requires careful consideration of the regulations regarding physicians' prescribing behavior, including policies that regulate prescription renewal, which could be a key driver of addiction and long-term opioid use (Chacko et al., 2017; Wen et al., 2017). A potential policy solution for addressing the negative consequences of long-term opioid use is to develop nationwide prescription drug monitoring programs that aim to moderate prescription opioid consumption by gathering information from physicians and making it harder for individuals to develop opioid addiction (Bao et al., 2016).

4.1. Strengths and limitations

The main strength of the present study was the use of the nationwide register data, combined with complete information on prescription opioid use and labor market indicators for the Finnish population. Our approach had limitations. First, the present study data do not cover all instances of opioid use, particularly illicit opioid use, and persons might not consume their medication as indicated by filled prescriptions. Although illicit drug use has increased among non-medical users of prescription drugs in Finland (Karjalainen et al., 2017), illicit opioid use is not a major public health concern. Second, an individual-level analysis would have allowed a more extensive set of controls that could have increased the precision of the estimates. Third, our empirical approach based on the instrumental variable estimation made it not straightforward to estimate potential nonlinear effects. Finally, the present study data do not contain information on cancer or non-cancer pain, which may affect opioid use.

5. Conclusion

Using the nationwide Finnish register data, we found that increased opioid use led to negative labor market outcomes in the long run. In contrast, in the short run, increased opioid use had positive employment effects. These findings indicate that regulating and monitoring long-term prescription opioids is crucial for reducing the negative consequences of opioid use for labor market performance. More research is needed to understand the process and conditions under which the short-term positive effects of opioid use transform to long-term negative labor market outcomes.

Contributors

MH and JV conducted the data analysis. MH acquired the funding. All authors contributed to the concept and design of the study, interpretation of the results, manuscript drafting and revision, and approved the final version of the manuscript.

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Declaration of Competing Interest

The authors report no declarations of interest.

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