Clinical Research Article

Current status of opioid prescription in South Korea using narcotics information management system

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ABSTRACT

Background: Recognizing the seriousness of the misuse and abuse of medical narcotics, the South Korean government introduced the world's first narcotic management system, the Narcotics Information Management System (NIMS). This study aimed to explore the recent one-year opioid prescribing patterns in South Korea using the NIMS database.

Methods: This study analyzed opioid prescription records in South Korea for the year 2022, utilizing the dispensing/administration dataset provided by NIMS. Public data from the Korean Statistical Information Service were also utilized to explore prescription trends over the past four years. The examination covered 16 different opioid analgesics, assessed by the total number of units prescribed based on routes of administration, type of institutions, and patients' sex and age group. Additionally, the disposal rate for each ingredient was computed.

Results: In total, 206,941 records of 87,792,968 opioid analgesic units were analyzed. Recently, the overall quantity of prescribed opioid analgesic units has remained relatively stable. The most prescribed ingredient was oral oxycodone, followed by tapentadol and sublingual fentanyl. Tertiary hospitals had the highest number of dispensed units (49.4%), followed by community pharmacies (40.2%). The highest number of prescribed units was attributed to male patients in their 60s. The disposal rates of the oral and transdermal formulations were less than 0.1%.

Conclusions: Opioid prescription in South Korea features a high proportion of oral formulations, tertiary hospital administration, pharmacy dispensing, and elderly patients. Sustained education and surveillance of patients and healthcare providers is required.

Keywords: Analgesics, Opioid; Medical Informatics; Narcotics; Opioid Epidemic; Opioid-Related Disorders; Oxycodone; Prescriptions; Prescription Drug Monitoring Programs.

INTRODUCTION

The global opioid crisis remains an ongoing concern as the unregulated prescription of opioids persists [1]. Ap-proximately 40 million individuals worldwide exhibited opioid dependency, with over 100,000 deaths attributed to opioid overdoses in 2017 [2]. In South Korea, opioid consumption, estimated as morphine milligram equiva-

lent (MME) per person, has increased over the past two decades [3]. Meanwhile, the illegitimate use of narcotic drugs has grown rapidly, leading to social problems [4]. According to a survey of individuals with narcotic addiction conducted by the National Center for Mental Health, 12% reported experiencing abuse of opioid analgesics, such as fentanyl [5]. In a recent survey conducted among Korean pain physicians, abuse or addiction was the most concerning side effect when prescribing opioids [6].

To address such a situation, health information technology for monitoring and managing opioid prescriptions would be beneficial [7]. The prescription drug monitoring program is an example that showed a reduction in opioid-related mortality following its implementation [8]. In this context, the Korean government developed the Narcotics Information Management System (NIMS) in 2014 and transitioned to an electronic reporting system in 2018 [9]. This system oversees the entire cycle of medical narcotics, from import and production to disposal, and its automatic guidance letter showed a decrease in the average prescription for several narcotics per patient [9].

A detailed analysis of opioid prescription patterns is required to formulate strategies in response to the increased opioid abuse in South Korea. Previous studies on trends in opioid use in South Korea that analyzed the national health insurance claims database primarily focused on chronic opioid users in sample cohorts or prescriptions only from outpatient clinics [10,11]. The NIMS database provides information on the entire process of the domestic distribution of narcotics.

Therefore, the authors aimed to comprehensively evaluate the status of opioid prescriptions in South Korea using the NIMS database. Using recent NIMS data, the authors analyzed the types of opioids prescribed, routes of administration, prescribing institutions, and demographic characteristics of patients for all opioid prescriptions in South Korea during the year. The findings are expected to contribute to the establishment of relevant policies and to guide future research on this significant issue.

MATERIALS AND METHODS

1. Data source and contents

Ethical review was exempted from the Institutional Review Board because this study did not contain personal information (Number: 2303-138-1416). The Korea Institute of Drug Safety and Risk Management (KIDS)

provided anonymized NIMS data through a medical narcotics big data utilization service, ensuring the protection of personal information. Four datasets were available for each stage of narcotics distribution: import/export, production, sales/purchase, and usage (dispensing and administration). A dataset was requested and obtained on opioid usage for the year 2022, as the NIMS provides data for a maximum of only one year.

The dataset from the NIMS consisted of the accumulation of every record of opioid prescriptions, and the variables for each record were as follows: handling practice (dispensing or administration), prescription date (month), location, type of institution, patient's sex and age group, drug ingredient, and name of the unit (ampoule, vial, tablet, patch, bottle). The dataset included only the monthly total number of drug units prescribed or disposed of, categorized by the above variables, rather than individual patient prescription details. For instance, the authors were able to identify that in January 2022, a total of 1,552 tablets of morphine were prescribed to all men in their 50s in all tertiary hospitals in Seoul. The route of administration was inferred from the drug units according to the following criteria: ampoule, vial (intravenous); tablet (oral, sublingual, buccal); patch (transdermal); bottle (spray).

This study included opioid analgesics, such as pethidine (meperidine), morphine, dihydrocodeine, hydromorphone, hydrocodone, oxycodone, tapentadol, buprenorphine, butorphanol, pentazocine, nalbuphine, remifentanil, alfentanil, sufentanil, and fentanyl. Codeine was excluded because it is primarily prescribed as an antitussive rather than an analgesic. Tramadol was excluded from the analysis because it is not yet classified as a narcotic drug in South Korea and therefore was not included in the dataset.

2. Data analysis

The primary outcome of this study was the cumulative number of units of each prescribed opioid analgesic in 2022. Secondary outcomes were the number of units prescribed in the last four years, the identity of the prescribing/dispensing institution, patient demographics, and the disposal rate by each ingredient and dispensing institution. The provided dataset included the prescription unit and the corresponding number of units prescribed; however, it lacked information on the dosage of each drug. Therefore, in this study, the prescription volume was estimated based on the sum of the total number of units prescribed, and the MME could not be calculated.

The total number of units prescribed was aggregated based on the following conditions to examine prescription patterns of opioid analgesics. First, to investigate the trends of prescription over recent years, the "medical narcotics prescription and administration" dataset between 2019 and 2022 was acquired from the Korean Statistical Information Service (KOSIS) [12]. The KOSIS provided data on the cumulative numbers for each category, including the number of prescribing institutions, prescribing physicians, patients, prescriptions, and units prescribed, related to medical narcotics between 2019 and 2022. Second, the number of units prescribed was calculated based on the type of ingredients and route of administration. Prescription routes were oral (including sublingual), intravenous, transdermal, and intranasal. Third, the number of units dispensed and prescribed were calculated based on the type of institution, including narcotic retail centers (pharmacies), primary clinics, secondary hospitals, tertiary hospitals, nursing hospitals, psychiatric hospitals, dental clinics, dental hospitals, public healthcare centers, and traditional medicine hospitals. Data providers confirmed that no overlap existed between hospital prescriptions and pharmacy dispensing. If opioids were prescribed by a hospital but dispensed by a pharmacy, the dispensing institution was classified as a pharmacy and the prescribing institution as a hospital. If the dispensing institution was classified as a hospital, this indicated cases where both prescriptions and dispensing or administration were conducted within the hospital. Fourth, the number of units prescribed was calculated based on the patient's sex and age groups at 10-year intervals. Finally, the disposal rate was calculated by considering the prescription and disposal quantities of each ingredient based on the route of administration. The disposal rate was also calculated by considering the dispensed and disposal quantities of each ingredient, based on the type of dispensing institution.

Only descriptive statistics were used in this study. Categorizing and aggregating data for analysis were performed using statistical computing R (version 4.0.0; R Foundation for Statistical Computing).

RESULTS

The entire dataset comprised 206,941 records of opioid analgesic prescriptions between January and December 2022. The cumulative number of all opioid analgesics prescribed was 87,792,968 units. In the analyzed NIMS data, no missing values were observed; however, when compared to the 2022 data from the KOSIS, differences were observed due to the privacy policy of KIDS (NIMS data: 87,792,968 *vs*. KOSIS data: 88,429,359). Upon inquiry into the KIDS, a response was received stating that information that could potentially identify individuals (with counts of three or fewer in each category of region, institution, sex, and age group) would not be provided. Except for those described under the 'Trends over the last four years' subheading, all the results were calculated based on NIMS data.

1. Primary outcome

The number of units of each prescribed opioid analgesic is presented in **Fig. 1**. The most commonly prescribed opioid analgesic by ingredient and administration route was oral oxycodone (45,990,455 units), followed by oral tapentadol, sublingual fentanyl, intravenous fentanyl, and intravenous pethidine. The oral route had 66,121,675 units prescribed, followed by 16,216,884 intravenously, 5,401,701 transdermally, and 52,708 intranasally.

2. Secondary outcomes

1) Trends over the last four years based on data from KOSIS

Trends in the prescription of opioid analgesics over the last four years are presented in **Table 1**. Compared to 2019, the number of prescribing institutions increased by 6.15%, whereas the number of prescribing doctors decreased by 1.78%. The number of patients prescribed was the lowest in 2020 (6,142,913); however, the number of prescriptions per patient was the highest (2.70 prescriptions per patient). The total number of prescriptions and the total number of units prescribed was highest in 2021.

2) Type of institution

Tertiary hospitals had the highest number of units dispensed across different types of institutions (43,335,343), followed by community pharmacies (35,325,396), secondary hospitals (7,012,793), primary clinics (1,171,633), and nursing hospitals (922,771) (**Fig. 2A**). In terms of prescriptions, tertiary hospitals again accounted for the highest number of units (74,405,900), followed by secondary hospitals (9,185,491), primary clinics (3,014,519), nursing hospitals (1,138,870), and traditional medicine hospitals (27,380) (**Fig. 2B**).
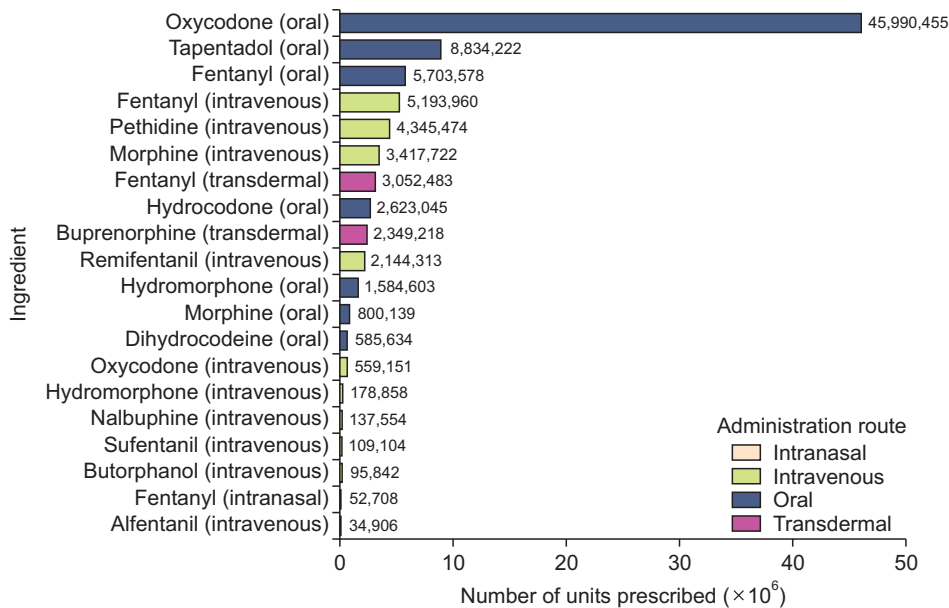
Fig. 1. The total number of units of opioid analgesics prescribed was examined based on administration routes in 2022.

Table 1. Trends in the prescription of opioid analgesics in South Korea between 2019 and 2022

Category	2019	2020	2021	2022	Change (%)
Institutions	18,736	19,624	20,112	19,889	6.15
Doctors	183,233	184,749	180,106	179,966	−1.78
Patients	6,475,834	6,142,913	6,496,095	6,459,098	−0.26
Prescriptions	16,570,240	16,563,781	17,146,170	16,554,080	−0.10
Units of opioids prescribed	88,454,717	89,643,652	91,432,599	88,429,359	−0.03
Prescription per patient	2.56	2.70	2.64	2.56	0.16

The total number of prescribing institutions and doctors, patients prescribed, prescriptions, and units of opioid analgesics prescribed are presented along with their values. The number of prescriptions per patient was calculated by dividing the number of prescriptions by the number of patients that received prescriptions. The change in value was calculated by dividing the difference between the 2019 and 2022 values by the 2019 values and multiplying them by 100 to convert them into percentages. All values were rounded off after the calculation.

3) Patient's sex and age

The number of units prescribed according to sex and age group is shown in **Fig. 3**. Among male and female patients, the highest number of units (male: 14,887,132 units; female: 9,592,086 units) were prescribed for individuals in their 60s. The number of units prescribed was generally higher for males than females, except for those aged group of 30s or over 80 years.

4) Disposal rate

Table 2 displays the units disposed and the corresponding disposal rate, relative to the prescribed unit count, for each ingredient analyzed based on the administration route. The highest disposal rate was achieved with intravenous alfentanil (29.81%). The disposal rates of the

three most prescribed opioid analgesics for the intravenous route, namely fentanyl, pethidine, and morphine, were 4.73%, 3.75%, and 6.49%, respectively. All ingredients administered via the oral or transdermal route had a disposal rate of less than 0.1%. The disposal rate discriminated by the type of institution and calculated as the units disposed over the units dispensed is presented in **Table 3**. The institutions with the highest disposal rates were dental hospitals (8.06%), traditional medicine hospitals (4.62%), and tertiary hospitals (2.11%), while pharmacies and dental clinics had disposal rates of less than 0.01%.

DISCUSSION

In this study, the current status of opioid prescriptions was identified in South Korea in 2022 using data provided
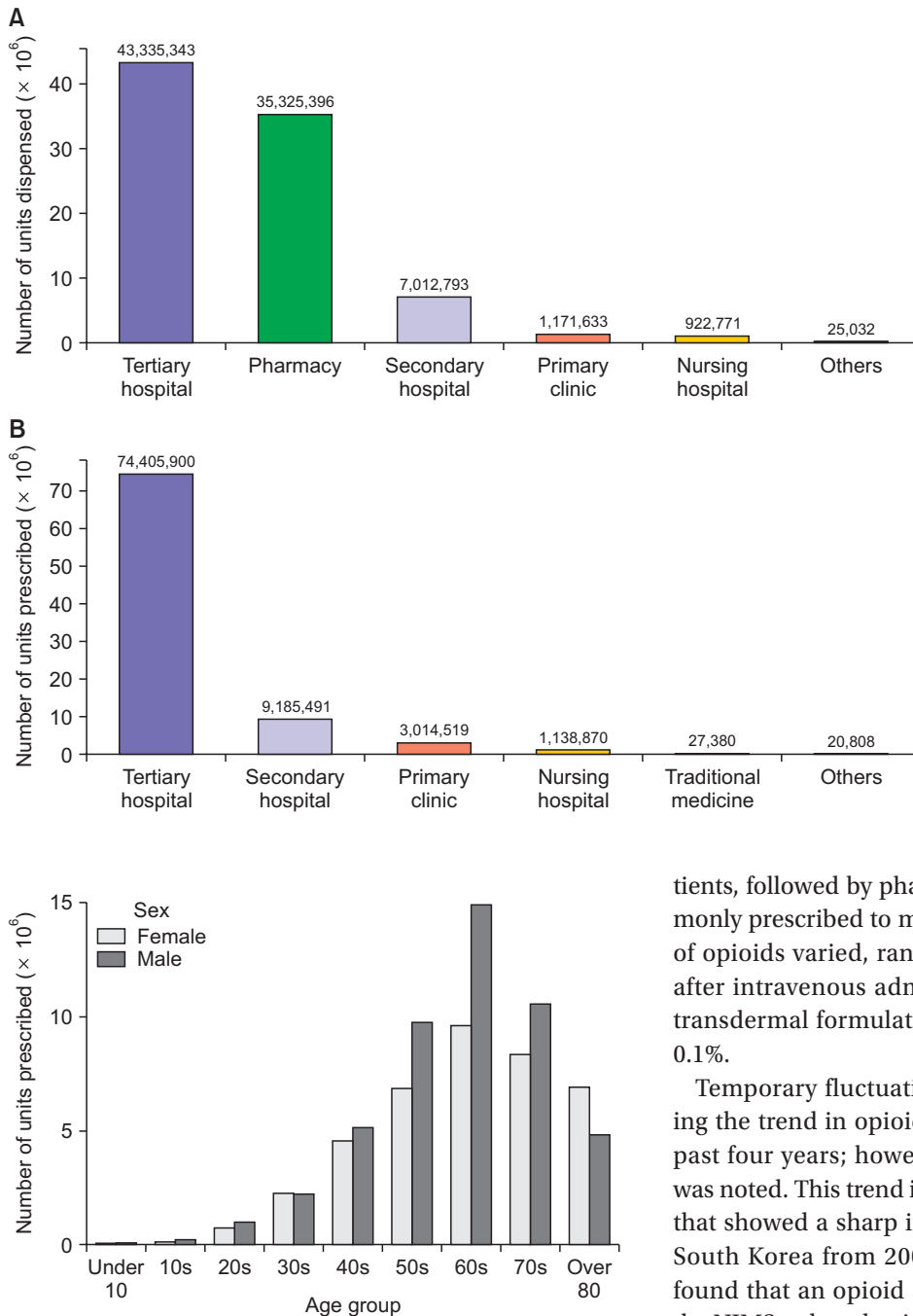
A

B

Fig. 2. The total number of units of opioid analgesics dispensed (A) and prescribed (B) was analyzed based on the type of institutions in 2022. In (A), 'others' included traditional medicine hospitals, psychiatric hospitals, dental hospitals, and dental clinics. In (B), 'others' included psychiatric hospitals, dental hospitals, dental clinics, and public healthcare centers.

Fig. 3. The total number of units of opioid analgesics prescribed was analyzed based on the patient's sex and age group in 2022.

by the NIMS. No significant change has been observed in the overall number of opioid analgesics prescribed over the past four years. In 2022, oral oxycodone was the most commonly prescribed opioid in South Korea. Tertiary hospitals were the primary institutions where opioids were most frequently administered or provided to pa-

tients, followed by pharmacies. Opioids were most commonly prescribed to males in their 60s. The disposal rate of opioids varied, ranging from approximately 1%–30% after intravenous administration, whereas all oral and transdermal formulations showed disposal rates below 0.1%.

Temporary fluctuations were observed when analyzing the trend in opioid analgesic prescriptions over the past four years; however, no significant overall change was noted. This trend is in contrast with a previous report that showed a sharp increase in opioid prescriptions in South Korea from 2002 to 2015 [13]. A previous study found that an opioid abuse prevention program within the NIMS reduced opioid overdose events [14]. Moreover, the introduction of the NIMS has been reported to reduce the prescription of narcotics, such as propofol, zolpidem, and anorectics [9]. However, in the present data limited to opioids, such beneficial trends could not be found. In a recent in-depth interview study conducted with doctors and pharmacists, it was reported that the NIMS is an administrator-centered system and, in clinical practice, it has caused more of an administrative burden rather than being effectively utilized to reduce narcotic prescriptions [15]. However, simultaneously, participants reported

Table 2. Number of units prescribed and disposed, and corresponding disposal rate of each ingredient in 2022

Route	Ingredient	Units prescribed	Units disposed	Disposal rate (%)
Oral	Oxycodone	45,990,455	1,243	< 0.01
	Tapentadol	8,834,223	26	< 0.01
	Fentanyl	5,703,578	423	< 0.01
	Hydrocodone	2,623,045	12	< 0.01
	Hydromorphone	1,584,603	145	< 0.01
	Morphine	800,139	218	0.03
	Dihydrocodeine	585,634	220	0.04
Intravenous	Fentanyl	5,193,961	245,928	4.73
	Pethidine (Meperidine)	4,345,474	162,925	3.75
	Morphine	3,417,722	221,664	6.49
	Remifentanil	2,144,313	215,848	10.07
	Oxycodone	559,151	86,867	15.54
	Hydromorphone	178,858	21,196	11.85
	Nalbuphine	137,554	4,545	3.30
	Sufentanil	109,104	30,882	28.30
	Butorphanol	95,842	928	0.97
	Alfentanil	34,906	10,406	29.81
Transdermal	Fentanyl	3,052,483	1,261	0.04
	Buprenorphine	2,349,218	207	< 0.01
Intranasal	Fentanyl	52,708	1,048	1.99
Total		87,792,971	1,005,992	1.15

The total number of units prescribed and disposed of for each ingredient is presented, along with their values. The disposal rate was calculated by dividing the number of disposed units by the number of prescribed units and multiplying by 100. All values were rounded off after summation and disposal rate calculations.

Table 3. Number of units dispensed and disposed, and corresponding disposal rates according to type of dispensing institution

Type of institution	Units dispensed	Units disposed	Disposal rate (%)
Tertiary hospital	43,335,343	914,619	2.11
Pharmacy	35,325,396	1,294	< 0.01
Secondary hospital	7,012,793	64,934	0.93
Primary clinic	1,171,633	20,139	1.72
Nursing hospital	922,771	3,867	0.42
Traditional medicine hospital	14,904	689	4.62
Dental hospital	5,531	446	8.06
Psychiatric hospital	3,240	2	0.05
Dental clinic	1,357	0	< 0.01
Total	87,792,968	1,005,990	1.15

The total number of units dispensed and disposed of by the type of dispensing institution is presented, along with their values. The disposal rate was calculated by dividing the number of disposed units by the number of dispensed units and multiplying by 100. All values were rounded off after summation and disposal rate calculations.

that they believed the NIMS could be helpful for narcotic management [15]. Therefore, further research is needed to explore the potential effects of the NIMS on reducing opioid prescriptions in South Korea.

The most commonly prescribed opioid in this study was oxycodone, which is consistent with the findings from other high-income countries [16]. In particular, orally administered oxycodone dominates over half of all units prescribed, and oral formulations can carry a higher risk of abuse than other formulation types [17,18].

Furthermore, the present study revealed that oral opioid formulations were rarely returned to medical institutions. Unnecessary opioids that have not been returned can lead to opioid misuse among the patient's acquaintances [19]. Moreover, oral oxycodone has been reported to have a higher risk of abuse than oral tapentadol, morphine, or hydrocodone [20,21]. Fentanyl, known for its high risk of abuse [22], was the second most commonly prescribed opioid when categorized by ingredient (combining all formulations). The abuse of fentanyl has become a significant global issue [22], and has recently emerged as a societal issue in South Korea as well [23]. Not only oral and intravenous formulations of fentanyl but also transdermal fentanyl patches have been identified as significant sources of abuse [22].

These results indicate the following considerations: First, the types of opioids to be prescribed and the differences in the risk of opioid misuse based on their ingredients and formulations need to be carefully considered. Compared to oxycodone and fentanyl, tapentadol has been reported to have a lower risk of abuse [24,25]. Second, the most frequently prescribed opioids were oral formulations that the patients self-administered. Therefore, patient education on opioid misuse is crucial for healthcare professionals and patients. Additionally, disposal systems such as patient education and local takeback programs should be established to encourage the return of unused opioids [26–28]. A recent study in the United States reported that half of the patients with prescribed opioids had not received education on opioid storage or disposal [29]. However, a recent systematic review of opioid disposal interventions reported conflicting findings and insufficient evidence for various interventions [30]. Therefore, further research on opioid disposal interventions is necessary in South Korea.

It is noteworthy that 40.2% of the total number of units were delivered to patients through pharmacies. Despite such a high proportion, the disposal rate for opioids dispensed by pharmacies was extremely low (less than 0.01%). This is likely because all opioids provided by pharmacies were dispensed to outpatients, making their retrieval more challenging. Although pharmacists do not prescribe or administer opioids, they place patients at the forefront of opioid dispensing. However, according to Article 50 of the Narcotics Control Act and Article 47 of its enforcement regulations, individuals involved in handling narcotics are required to receive only a 2-hour education session within one year of obtaining their position [31]. If enhanced and proper education is provided, pharmacists could play the role of vigilant monitors and local consultants in opioid management [32]. A recent study revealed that an educational program for pharmacists had an impact on their practice behavior, indicating its potential to reduce opioid misuse [33].

Another notable finding of the present study was that opioid prescriptions were most frequent among men and women in their 60s, followed by those in their 70s. This was an expected outcome because of the higher prevalence of cancer-related pain and other chronic pain conditions in the elderly population [34]. However, prescribing opioids to elderly patients is challenging for the following reasons. First, elderly patients may have cognitive impairment, which can make it difficult for them to understand patient educational interventions. Second, providers may have difficulty assessing pain in older adults because pain is subjective and difficult to measure. Consequently, elderly patients face a higher risk of inappropriate opioid prescriptions and encounter difficulties in receiving adequate education on opioid management, such as appropriate self-administration and disposal of unused opioids [35]. Opioid misuse is also relatively common among elderly patients [36], and recent opioid misuse among the elderly has recently become a serious problem [37,38]. Given the rapidly aging South Korean population, policy efforts are imperative to address these challenges.

This study had several limitations. First, the data provided by the NIMS were limited to only one year, which made it difficult to investigate the temporal trends of opioid analgesics in terms of the types of ingredients and formulations. To overcome this restriction, prescription data from the KOSIS in recent years, was incorporated. Second, the data only included the number of units prescribed for each medication and lacked specific dosages. Additionally, information on various types of dosage formulations containing the same active ingredient was not provided. Consequently, quantitative comparisons of opioid use, such as MME, could not be conducted. Third, the authors could not verify the specific drug formulations beyond the route of administration. Although a significant portion of prescribed oral oxycodone in South Korea is presumed to be an abuse-deterrent opioid formulation, such as Targiniq ER [39], the data did not provide specific details about the oral formulation. Fourth, the number of prescriptions per patient was evaluated by dividing the total annual number of prescriptions by the annual number of patients who received prescriptions. This approach failed to capture information on a minority of heavy opioid users. Additionally, due to the lack of individual patient prescription records in the

data provided by the NIMS, the authors were unable to obtain additional information such as the frequency of repeated prescriptions or co-administration of opioids. Finally, the limitation of lacking patient information beyond demographic data, such as pain-related diagnoses, medical history, and concurrent medications, should be acknowledged. A database encompassing opioid dosages and patients' medical profiles would be advantageous for assessing and managing opioid usage more effectively. Despite these limitations, this study analyzed the data for almost all opioid analgesics prescribed in South Korea in 2022.

In conclusion, this study of opioid analgesics prescribed in South Korea in 2022 indicated no significant trend in the prescription volume of opioids, the prevalence of oral formulations, particularly oxycodone, the predominance of tertiary hospitals and pharmacies among prescribing institutions, and the highest number of units prescribed among males in their 60s. In the future, a more thorough assessment of prescription patterns over an extended period is necessary to incorporate data on drug dosages and patient medical histories.

DATA AVAILABILITY

The datasets used and/or analyzed during the current study are available from the KIDS upon request for research purposes or from public data provided by KOSIS.

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CONFLICT OF INTEREST

Ho-Jin Lee is a section editor of the Korean Journal of Pain; however, he has not been involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflict of interest relevant to this article was reported.

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AUTHOR CONTRIBUTIONS

Soo-Hyuk Yoon: Writing/manuscript preparation; Jeongsoo Kim: Writing/manuscript preparation; Susie Yoon: Writing/manuscript preparation; Ho-Jin Lee: Supervision.

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