







Cite as: Archiv EuroMedica. 2024. 14; 6. DOI [10.35630/2024/14/6.603](https://doi.org/10.35630/2024/14/6.603)

Received 4 September 2024;  
Accepted 11 December 2024;  
Published 16 December 2024

## HOW DOES PAIN MANAGEMENT DIFFER - THE BASICS OF ANALGESIA IN PEDIATRIC PATIENTS COMPARED TO THE ADULT POPULATION

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### ABSTRACT

Pain management is a key component of medical care that shows significant differences in pharmacodynamics, epidemiology or psychological approaches between pediatric and adult patient populations. An analgesic drug is an agent used to treat pain. It is often inadequate and ineffective in pediatric patients - the younger the children, the less likely they are to receive adequate analgesia. Optimizing pain management in both populations requires continuous improvement in clinical practice and education of medical personnel and patients on pharmacological and non-pharmacological approaches. This article discusses the characteristics of analgesic use in children and adults and non-pharmacological approaches to pain management.

**Objectives:** The purpose of our study is to evaluate the methods of analgesia used in the pediatric population and in adult patients and the differences associated with age group membership.

**Materials and Methods:** The literature review was performed using Internet research paper databases (PubMed, Google Scholar, Medline), using 28 articles available in English and Polish from 1983-2024.

**Results:** Analgesia in children has its own specific characteristics that differ from analgesia in adults. These include differences in pain sensitivity, age dependence, pain rating scale, psychological aspects, choice of analgesic drug or drug dosage. **Conclusion:** Improving the quality of analgesia in children requires both pharmacological support and the use of non-pharmacological methods, education of doctors and parents, and emotional support.

**Keywords:** Analgesia, analgesic agents, pain assessment scales, pain management, pediatrics

### INTRODUCTION

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage" [1,2,3,12]. It is a highly complex, multifaceted interaction involving physical, chemical, humoral, affective (emotional), cognitive, psychological, behavioral, and social elements [3]. The frequency and intensity of pain depend on the type of underlying disease as well as its stage of progression. Pain management in children and adults is based on a multimodal analgesia strategy that combines pharmacological and non-pharmacological aspects of pain therapy [2,5,6,8,10]. The most commonly used

analgesics include acetaminophen, NSAIDs, and opioids, often in combination with adjuvants [8].

**Objectives:** The purpose of our study is to evaluate the methods of analgesia used in the pediatric population and in adult patients and the differences associated with age group membership.

## MATERIALS AND METHODS

The literature review was performed using Internet research paper databases (PubMed, Google Scholar, Medline), using 28 articles available in English and Polish from 1983-2024.

### MAIN BODY

#### ANALGESIA AND CLASSIFICATION OF ANALGETIC DRUGS

Analgesia is defined as the relief of pain without intentionally inducing an altered mental state, such as sedation [28]. Analgesics are drugs used to treat pain, which are classified into categories that include non-opioid analgesics, which include paracetamol (acetaminophen), nonsteroidal anti-inflammatory drugs (NSAIDs), adjuvants like antidepressants and antiepileptic medications, and opioid analgesics [27].

#### PAIN ASSESSMENT IN ADULTS AND CHILDREN

The most recommended method for pain assessment is self-report [1,2,4], which is the most accurate and reliable evidence of pain, used from the age of 5 years [4]. For adults, the most useful scales are the Visual Analog Scale (VAS), the Verbal Rating Scale (VRS), and the Numeric Rating Scale (NRS) [9,12]. In children, the Wong-Baker FACES Pain Scale, VAS, and NRS are commonly used methods [1,2,4,6]. When reliable self-assessment of pain is not available, accepted methods include observational-behavioral tools that reflect the patient's response to pain [1,2,12]. The most reliable for adults are the Behavioral Pain Scale (BPS) and the Critical Care Pain Observation Tool (CPOT) [12]. Examples of scales for newborns include the Premature Infant Pain Profile (PIPP), Cry, Requires Increased Oxygen Administration, Increased Vital Signs, Expression, Sleepless (CRIES), and the COMFORT scale [2,4]. The FLACC scale is the most appropriate measurement tool for assessing pain in infants [2].

#### PAIN MANAGEMENT IN ADULTS AND CHILDREN

Pain management in children and adults is based on a multimodal analgesia strategy that includes both pharmacological and non-pharmacological interventions [2,5,6,8,10]. However, non-pharmacological measures should be preferred as the foundation of pain management for both adults and children [2]. Pharmacological treatments are used according to the WHO analgesic ladder, which serves as the basis for pain treatment and upon which more modern therapy techniques can be built [1,6]. It is recommended to start therapy with the lowest possible dose and gradually increase it, using multiple medications in parallel to reduce the total dose of any single drug [10]. The most commonly used painkillers include acetaminophen, NSAIDs, and opioids, often in combination with adjuvants (e.g., muscle relaxants, anticonvulsants) [8]. The oral route is the most convenient for drug administration as it does not cause additional discomfort and pain for patients [14].

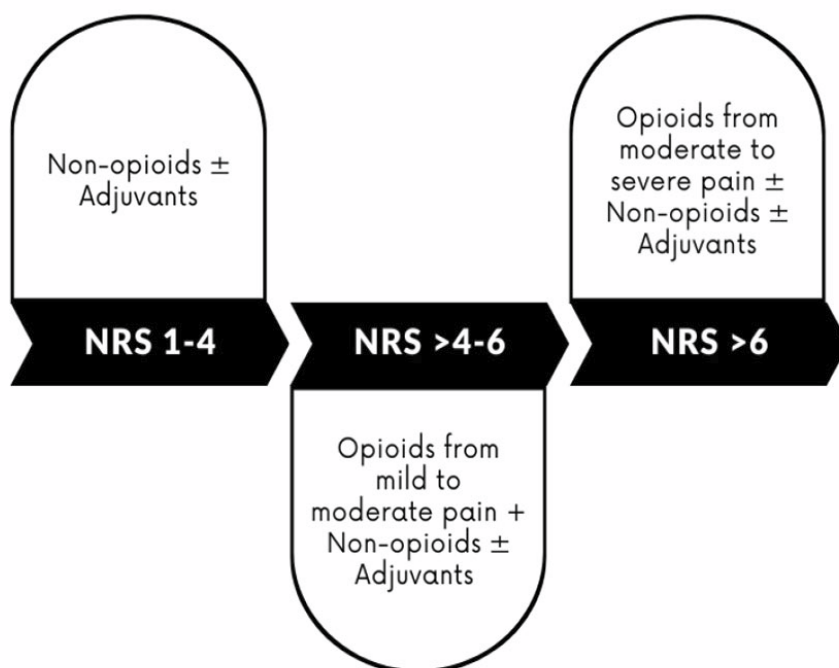


Fig. 1. WHO Analgesic Ladder [1,2,22]

### PARACETAMOL (ACETAMINOPHEN):

Acetaminophen is considered effective and safe for relieving pain ranging from mild to severe, and it is used as an adjunct therapy to opioids in both children and adults [1,2,7,8,10,11]. It can be administered rectally, orally and intravenously [1,7,11]. The rectal preparation is avoided in adults due to its variable and slow absorption [7], whereas it is routinely used in infants and young children who have difficulty taking the medication orally [2,14]. The dosing of acetaminophen in children depends on the route of administration, age, and weight, while in adults, the recommended dose is 650 mg to 1000 mg every 4-6 hours, not exceeding 3 grams per day [1,2,7,11]. Acetaminophen should be avoided in patients with active liver disease, as an overdose can lead to acute liver failure [3,10]. It is estimated that it takes 15 grams of acetaminophen to cause liver damage in an adult, and more than 3 grams in a child under 2 years old [3].

### NSAIDS:

NSAIDs are prescribed to children and adults for mild to severe pain at the lowest effective dose for the shortest possible duration [7,8]. They are available in oral, rectal, intravenous, and intramuscular forms [1,11]. In pediatric practice, diclofenac, ketoprofen, ibuprofen, naproxen, and tolmetin are commonly used, while adults also use celecoxib, meloxicam, indomethacin, and acetylsalicylic acid [1,2,3,7,11]. Acetylsalicylic acid is not recommended for children due to potential complications such as Reye's syndrome [3].

For ibuprofen, the most commonly used NSAID, the dosage for children is 5-10 mg/kg every 6-8 hours, with a maximum daily intake of 30 mg/kg [1,2]. For adults, the dosage is 400 mg every 4 to 6 hours, with a maximum daily dose of 1200 mg [9]. Ibuprofen is more effective than acetaminophen and as effective as the combination of acetaminophen and codeine in pain treatment [1,8]. Ibuprofen should not be used in children under 3 months of age primarily due to insufficient clinical data and to avoid masking the diagnosis of serious infections or sepsis [1,15]. Additionally, ibuprofen has fewer gastrointestinal side effects than other NSAIDs in both adults and children [1,11]. In the elderly, caution should be exercised when using NSAIDs, and they should be administered at appropriately reduced doses [6,9,10,11].

### OPIOIDS:

Opioids are recommended for children and adults with moderate to severe pain when other treatment methods do not provide sufficient relief [1,8,9,12]. Although opioids are indicated for both acute and chronic pain, it is advised to prescribe them at the lowest effective dose and for the shortest duration possible, only when the expected benefits in terms of pain and function outweigh the risks [7]. Opioid analgesics include among others morphine, buprenorphine, fentanyl, codeine, hydrocodone, oxycodone, methadone, and

hydromorphone [1,3,5]. They are available through various routes of administration, depending on the severity of pain and the patient's condition [1,6,7]. Preferred routes include oral and intravenous administration, while in palliative care, both in children and adults, transdermal applications such as fentanyl and buprenorphine patches are commonly used [1,11,20,21]. Intravenous morphine is often the first medication used for severe pain [1,2,5,6]. The typical dose of morphine for adults is 0.1-0.2 mg/kg intravenously; however, dosing should be adjusted to achieve the desired effect, with lower doses recommended for older adults [1,11]. In children, there are differences in pharmacokinetics, particularly in the drug's half-life across various age groups, which can lead to differences in morphine dosing. For infants aged 1-6 months, the dosing is 50-150 µg/kg every 4 hours; for those aged 6 months to 12 years, 100-300 µg/kg every 4 hours; and for children aged 12-18 years, 3-20 mg every 4 hours [2].

For moderate pain in children and adults, codeine (usually in combination with acetaminophen) and tramadol are commonly used [1,2,3,6,11,13]. Orally, codeine is administered at doses of 0.5-1 mg/kg every 6-8 hours, while tramadol is given at 1-2 mg/kg every 6-8 hours [1]. Intravenous tramadol is administered at a dose of 1 mg/kg every 4-6 hours [1]. There are documented cases of rare but fatal outcomes associated with codeine use, particularly due to the risk of respiratory depression in children under 12 years of age, related to their higher activity of hepatic cytochromes metabolizing the substance. Consequently, codeine is no longer recommended for pain management in children in many countries [2,3]. In adults with rapid drug metabolism, even small doses of codeine carry the risk of respiratory depression and excessive sedation, making morphine a safer alternative to codeine [2]. Acetaminophen-codeine combinations significantly enhance analgesic effects, offering longer and more effective pain relief compared to either drug alone [11,13]. The combination of tramadol and acetaminophen is effective in treating various pain conditions and is generally well-tolerated and safe [20]; however, repeated use of this combination increases the occurrence of side effects [17]. Fentanyl is a short-acting opioid that is more potent than morphine and has a higher safety profile, often used in children for the treatment of acute pain in intravenous, inhaled, sublingual tablet, or transdermal patch forms [1,2]. However, the drawbacks of fentanyl primarily include respiratory depression, fatigue, drowsiness, or sedation. The drug can also impair the ability to think clearly, speak, and walk properly [16]. Fentanyl is known for requiring significant dose escalation due to tolerance and is also associated with opioid-induced hyperalgesia [1,23]. This condition involves the paradoxical appearance or worsening of pain symptoms during the use of the drug. If opioid-induced hyperalgesia develops and is recognized, a dose reduction or opioid rotation should be considered [23].

Fig. 2. Opioid Dose Equivalence [24,25,26]

Drug	P.O.	Parenteral
Morphine	30 mg	10 mg
Codeine	200 mg	100 mg
Hydrocodone	20-30 mg	-
Hydromorphone	7,5 mg	1,3-1,5 mg
Oxymorphone	10 mg	1 mg
Oxycodone	20-30 mg	10 mg
Tramadol	120 mg	100 mg
Meperidine	300 mg	75-100 mg
Tapentadol	100-150 mg	-
Methadone	Variable drug Titration	Variable drug Titration
Buprenorphine	-	0,3 mg
Fentanyl	Transdermal - 12,6-25 mcg/hr Parenteral - 0,1 mg	

### ADJUVANT ANALGESIA:

Adjuvant analgesia are commonly used in pain management for both adults and children and can be used

alone or in combination with non-opioid or opioid analgesics [5,9]. Their aim is to achieve optimal pain control by providing additional analgesic effects or enhancing the response to primary pain medications [5,9,10]. They are particularly recommended for managing neuropathic pain [9,10]. Commonly used adjuvants include gabapentin, pregabalin, amitriptyline, duloxetine and lidocaine [6,7]. In children, the effectiveness of intranasal ketamine for managing moderate to severe acute pain has been confirmed [1,5,6].

## NON-PHARMACOLOGICAL TREATMENT

In every age group, non-pharmacological pain management methods are used as adjuncts to pharmacological treatment and include psychological, behavioral, and physical interventions [1,2,6,11]. Non-pharmacological strategies focus on relaxation, physical activity or immobilization of the patient [6,10,11]. In children, distraction techniques and breastfeeding are commonly employed [1,2,5].

## DISCUSSION

The key differences in pain management between children and adults lie in the psychological perspective. Adults are aware of the existential threat that pain can pose, which can amplify their experience of it. This perspective is not always present in children. Additionally, anxiety in young patients can significantly exacerbate pain, making it challenging to differentiate between pain and anxiety [18]. Similarities in pain therapy include the use of medications, while differences are primarily due to age, physiology, and treatment preferences. Differences may include the assessment of pain intensity, medication dosing, and preferred routes of administration. In children, behavioral assessment scales are more frequently used due to their inability to articulate their pain compared to older patients, who use self-reporting to determine pain intensity. Compared to adult patients, pediatric patients with the same diagnosis often receive lower doses of analgesics, and the younger the child, the less likely they are to receive adequate analgesia [5]. One study attributed this to reasons such as: 1) children experiencing less pain, 2) children being less effective in communicating their pain sensations, 3) healthcare workers' concerns about side effects from strong analgesics, or 4) children requiring smaller doses of medication for pain relief because these drugs are distributed, metabolized, and excreted differently than in adults [19]. Differences between age groups include variations in drug half-life and volume of distribution [2,19]. Pain medication dosing in young patients depends on their age and weight. For children, age-appropriate forms such as syrups, tablets, or suppositories are used, while adults more commonly use tablets or injections [14]. Collaboration with caregivers and consideration of age-related restrictions on certain medications, such as ibuprofen, are also important.

## CONCLUSIONS

Comprehensive analgesia pain treatment and prevention in pediatrics and adults may include pharmacological methods (e.g., primary analgesics, opioids and adjunctive analgesics), rehabilitation, psychological approaches and integrative techniques. Such a complex acts synergistically to provide more effective control of acute pediatric pain with fewer side effects than any single analgesic or medical modality.

Considering the treatment of pain in children, it has its specific features like:

1. Pain sensitivity - their reactions to pain may be more intense and their pain threshold may be lower,
2. Age dependency - pain sensitivity and responses to pain medications may vary by age,
3. Pain Rating Scale - methods for assessing pain in children differ from those used in adults. In children, the VAS is more often used,
4. Choice of analgesic drug - the choice of drugs used for analgesia in children is often limited due to the child's age and the risk of side effects,
5. Dosage - the dosage of painkillers in children is often calculated based on their body weight, which requires accuracy and care in calculations.

Understanding these specifics is key to effectively managing pain in children and making them comfortable in medical situations. Improving the quality of analgesia in children requires both pharmacological support and the use of non-pharmacological methods, education of doctors and parents, and emotional support. This can help manage pain more effectively, providing young patients with better medical care and faster recovery.

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