KUBICKA, Maria, POLAŃSKA, Paulina, GRUSZKA, Marta and ZAKROCKA, Martyna. Analysis of poisoning with OTC drugs for suicidal purposes among children and adolescents in Poland in the period 2012 - 2023: Paracetamol as the most frequently used substance in intentional poisonings. Journal of Education. Journal of Education, Health and Sport. 2025;78:57622. eISSN 2391-8306.
https://doi.org/10.12775/JEHS.2025.78.57622
https://apcz.umk.pl/JEHS/article/view/57622

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 07.01.2025. Revised: 07.02.2025. Accepted: 07.02.2025. Published: 10.02.2025.

Analysis of poisoning with OTC drugs for suicidal purposes among children and adolescents in Poland in the period 2012 - 2023. Paracetamol as the most frequently used substance in intentional poisonings

Authors:

MD Maria Kubicka[1], MD Paulina Polańska[2], MD Marta Gruszka[3], MD Martyna Zakrocka[4]

[1] Faculty of Medicine, Wroclaw Medical University, Wybrzeże L. Pasteura 1, 50-367 Wroclaw, Poland;

maria.kubicka@student.umw.edu.pl

ORCID 0000-0001-6913-9914

[2] 4th Military Clinical Hospital in Wrocław, Weigla 5, 53-114 Wrocław, Poland;
polanska.paulina@gmail.com
ORCID: 0009-0004-2365-7977

[3] 4th Military Clinical Hospital in Wrocław, Weigla 5, 53-114 Wrocław, Poland;
kulacz.marta@gmail.com
ORCID: 0009-0003-0775-3451

[4] Lower Silesian Oncology, Pulmonology and Hematology Center, pl. Ludwika Hirszfelda 12, 53-413 Wroclaw, Poland;
zakrockamartyna@gmail.com
ORCID: 0009-0004-5091-5919

Abstract

Introduction and Purpose: Drug poisoning among children and adolescents is an increasing public health issue worldwide and in Poland. Intentional poisonings, especially suicide attempts, are on the rise, often involving over-the-counter (OTC) medications, with paracetamol being the most commonly used substance. This paper aims to analyze the prevalence, characteristics, and implications of drug poisonings in youth, focusing on social and mental health factors, particularly during the COVID-19 pandemic.

Materials and Methods: The study is based on retrospective data collected from Polish cities published between 2014 and 2023, examining hospital admissions, demographic trends, and poisoning agents.

Results: The study reveals a significant increase in suicide attempts, especially during the COVID-19 pandemic. Paracetamol poisoning remains the leading cause of intentional overdoses, with severe cases potentially resulting in acute liver failure or death if untreated. Girls account for a disproportionate number of cases, and many adolescents who attempt suicide lack prior psychiatric diagnoses. Seasonal trends and shifts in age demographics suggest changing patterns in poisoning incidents.

Conclusions: The findings emphasize the need for improved mental health education, early intervention, and caregiver awareness. Strengthening psychological support and implementing stricter regulation of OTC drugs are crucial to addressing the root causes of youth suicide

attempts. Proactive measures, such as teaching problem-solving skills and expanding access to mental health services, are essential to mitigating this growing public health challenge.
Key words: suicide attempt, paracetamol, poisoning

Introduction

Poisoning is defined as a medical condition caused by a toxic substance entering the body from the external environment. The increasing prevalence of intentional poisoning in children is a medical, psychological and social problem. The phenomenon is reaching similar proportions to injuries or accidents that are common in this age group. [1]

The overdose of drugs by adolescents for suicidal or intoxicating purposes is a problem in Poland and worldwide. The most common drugs used for this purpose are over-the-counter (OTC) drugs, as opposed to Rx drugs, which are prescribed by a doctor. [2] Some common painkillers, cold remedies and antihistamines also contain psychoactive substances such as pseudoephedrine, ephedrine, codeine and others. [2,3] Pharmaceutical substances are used in suicide attempts mainly by female patients. The most commonly used drugs are painkillers, and the most commonly reported substance is paracetamol. [2]

Description of the problem

Acute drug poisoning is the most common cause of hospital admissions to toxicology departments. [4] Within the group of suicide poisonings, drugs are the most common toxic agent, accounting for 90% of all suicide attempts in adolescents. Acute poisoning deaths are most common after ingestion of opiates, psychoactive substances, paracetamol, salicylates, cardiovascular drugs and psychotropic drugs.[5]

The literature reports paediatric cases of intentional and unintentional drug poisoning.[6] There are also examples of patients who have become dependent on the drugs used.[2]

According to the data analysed, the incidence of drug poisoning has remained similar in all age groups for many years. In recent years, with the increase in suicide attempts, there has been an increase in suicidal poisoning among children and adolescents up to the age of 18. Data from the Police Headquarters show that in 2021, 1,496 children and adolescents under the age of 18 attempted suicide (85 attempts were made by children between the ages of 7 and 12). Of these attempts, 127 were fatal. Compared to 2020, this represents a 77% increase in suicidal behaviour and a 19% increase in deaths. From January to November 2023, 1,966 suicide attempts were recorded among children and adolescents. [7]

Literature review

The paper is based on data from retrospective studies from several selected Polish cities (Warsaw, Suwałki, Krakow, Lublin, Białystok, Poznań) [2,5,6,8,9] published between 2014 and 2023. Drug poisoning is more common among girls than boys in all measurements. At the Regional Hospital in Suwałki between 2013 and 2018, girls were the largest group of poisoned patients among those surveyed, accounting for 56% of all children admitted to the hospital; boys were a slightly smaller group, accounting for 44% of patients.[8] In the 2022 Lublin study, female poisonings accounted for 70%. [9] A similar finding of 80% of poisonings in girls was reported in a study conducted in Krakow during the pandemic. [5]

In a study published in 2017 by D. Suchecka et al. from Białystok and Poznań, intentional poisonings outnumbered accidental ones, and the largest group hospitalised for thwarted suicides in Poland were girls aged 12-14 years.[2] Similar findings were presented by T. Jackowska in 2014, analysing the largest group of 18,000 children cited in the Polish literature, in which 54.8% of patients deliberately and intentionally ingested a substance leading to poisoning.[6] In the peri-pandemic period in a hospital in Lublin, 94.2% of poisonings were intentional and 39.8% were suicide attempts.[9] In Krakow in 2021-2022, 52.4% were suicides. During the COVID-19 pandemic, 69% of hospital admissions were for attempted suicide among patients aged 15-17 years. [5] In contrast to surveys conducted five years earlier, suicide attempts were twice as common in the 15-17 age group as in the 11-14 age group. [8]

Accidental poisoning mainly affects young children up to the age of 5, most frequently between the ages of 2 and 3. The incidence of this type of poisoning decreases with age.

There are discrepancies in the seasons cited to confirm the seasonality of the number of intentional drug poisonings in children. D. Suchecka writes of a spring-summer seasonality, Milewska E. of an early spring seasonality, while Sosnowska W. notes that the highest number of cases occurs in autumn. [2,8,9] However, the results of the studies from Krakow and Lublin unanimously show that the frequency of suicide attempts by teenagers increased with the duration of the epidemic. An example is April 2022, when more than twice as many suicide attempts were recorded as in April 2021 and up to 13 times as many as in the corresponding month of 2020. [5,9]

During the pandemic period, drugs were the main poisoning agent, accounting for 55% of poisonings. Drugs and ethanol accounted for 29.2% and 28.3% respectively. Drugs were more often chosen for suicide by girls than by boys. Alcohol, on the other hand, was used more

often by boys. 83% made one suicide attempt and 17% made at least two attempts during the period. [5,9]

One in four hospital admissions was due to young people using two methods to end their lives - the most common being self-poisoning and self-harm. In a study carried out in Krakow between 2020 and 2022, three methods of attempted suicide (including hanging) were recorded in two boys and one girl in the over-14 age group.[5] A similar selection of substances according to gender was shown by W. Sosnowska.[9] Drugs were the most common cause of poisoning in girls, accounting for 63.1 per cent of the patients surveyed. The percentages of ethanol and drug poisoning were similar to those in the above study, with ethanol poisoning occurring in 23.8% and drug poisoning in 21.4%. In boys, drugs were the most common cause of poisoning. Drug intoxication was found in 47.2% of the patients studied. Ethanol was consumed by 38.9% and drugs by 33.3% of the boys. [2,5,6,8,9]

Multi-substance poisoning accounted for 8.9% in a nine-year study completed in 2012 in Warsaw.[6] Ten years later, results from a study in Lublin showed a similar figure of 7%.[9]

Most poisonings caused by taking medicines that can be bought without a prescription are due to drugs in the analgesic, antipyretic or respiratory group.[2] They are also a method of attempted suicide, especially among girls. In all the studies collected, paracetamol is the substance responsible for the highest number of intentional poisonings. Starting with the oldest of the collected studies, poisoning with this substance accounted for 27.3% (Warsaw).[6] In the 2013-2018 analysis of a group of patients aged between 9 and 18 years, it was 7%, again the highest percentage for a single substance.[8] During the pandemic period, antidepressants and antipsychotics had the highest percentage of all drugs used for self-poisoning, both for mono- and multi-drug poisoning, but when considering a single substance rather than a group of drugs, paracetamol was the most commonly used.[5,9] Similar findings were reported by Rita Farah et al, who showed that during the COVID-19 pandemic, suicide attempts involving intentional drug use increased among children and adolescents. The substances most commonly implicated in overdose were paracetamol and ibuprofen, sertraline, fluoxetine and diphenhydramine. [10]

The COVID-19 pandemic had a particular impact on the deterioration of young people's mental health. Data show that surveys conducted in 2020 and 2021 indicate higher than usual levels of stress, insomnia, anxiety and depression in the general population during the COVID-19 pandemic. The chronic stress of uncertainty, lack of peer contact and inadequate mental health support during this difficult time has become a serious threat to the mental health of children and adolescents.[11]

Paracetamol the most frequently chosen substance for suicidal purposes

Paracetamol is one of the most common drugs accidentally ingested by children.[12] The link between paracetamol and hepatotoxicity is well established. Its widespread use has made it one of the most common drugs associated with both unintentional and intentional poisoning and toxicity. Although therapeutic and unintentional overdoses usually occur in children, liver damage or death from paracetamol poisoning appears to be rare compared with adults. Nevertheless, paracetamol is currently the most important and common identifiable cause of acute liver failure in children. [13]

An analysis of paediatric cases of chronic paracetamol poisoning suggests that the safety margin for frequent use of therapeutic doses of paracetamol in infants and young children is much lower than previously thought.[12] Childhood poisoning represents a pervasive and substantial public health concern, with a heightened prevalence observed among children under five years of age, attributable to their innate inquisitiveness and tendency towards impulsive behaviour. [14] The paper, published by A Penn and N Buchanan, highlights the need to reassess the safety of paracetamol in the context of chronic therapy in infants and young children. [12]

It is frequently asserted that an act of suicide represents a cry for help. In accordance with the findings of international research, the 2020 pandemic has had a significant impact on the frequency of suicide attempts among children. [15]

Studies from Poland show that a increase in suicide attempts was observed in the context of the COVID-19 pandemic, when adolescents experienced social isolation, anxiety about the future and a decrease in the availability of psychological support.[5,9]

Although a number of steps have been taken in Poland in recent years to increase the availability of psychological and psychiatric support, the results show an increase in the number of suicide attempts, especially during periods of crisis, suggesting a need to improve the support system in the face of changing social and psychological conditions.[7]

Paracetamol poisoning in Poland and worldwide

In Poland and worldwide, paracetamol poisoning represents a significant cause of drug poisoning cases among adolescents. [6-9] The data are worrying given that paracetamol is usually perceived as a safe drug with minimal risk to healthy adults. However, the reality is that its overdose can lead to severe liver damage and, in extreme cases, death. [16]

A similar trend is observed on a global scale. For instance, in 2021, US poison centres received over 80,000 cases involving paracetamol.[17] In Australia, paracetamol is a frequently prescribed medication for cases of intoxication and accidental overdose in both

adults and children. Paracetamol poisoning has been identified as the most prevalent cause of severe acute liver injury in the country.[18] In Canada, it is estimated that approximately 4,500 hospital admissions per year are attributable to paracetamol. [17]

A popular painkiller - the effects of overdose

The choice of paracetamol as a deliberate poisoning agent is probably due to its popularity, its availability in pharmacies and the fact that it can be bought without a prescription. Children can often find it at home or buy it themselves from a pharmacy without arousing the suspicion of the pharmacist.[2]

Groups with a heightened risk of toxic poisoning and liver damage can be identified. Such groups may include patients suffering from glutathione deficiency, for example those with diabetes, malnourished individuals, and those prescribed antiepileptic medications that induce cytochrome P-450, such as carbamazepine or phenytoin. [19,20]

The toxic effects of the pharmaceutical compound may be observed in patients experiencing elevated stress levels when administered a dosage lower than the previously mentioned 6 g. The onset of toxic effects has been documented as early as 4 g or 100 mg/kg/day. There is an increasing body of evidence suggesting a link between the occurrence of liver damage and deaths from liver failure and the development of chronic liver disease. Furthermore, there is a growing association between liver failure and the chronic use of excessive doses of paracetamol. [21-23]

It has been demonstrated that doses exceeding 100 mg/kg/day in paediatric patients may result in hepatotoxicity when administered repeatedly over several consecutive days. For children under the age of six doses exceeding 200 mg/kg over 8-24 hours, doses exceeding 150 mg/kg/day for two days, or doses exceeding 100 mg/kg daily for three days or longer should be avoided. In patients older than 6 years, hepatotoxicity will become apparent with doses >10 g or 200 mg/kg per day or after >6 g or 150 mg/kg per day for 2 days or more. [24]

The bioavailability of the substance is dose-dependent, ranging from 70 to 90%. The rate of oral absorption is principally influenced by the rate of gas expulsion, retardation by food, propantheline, pethidine and diamorphine, and is augmented by metoclopramide. Paracetamol is also well absorbed from the rectum. [25]

The oxidation reaction involving the CYP2E1 isoform results in the production of the following toxic metabolite: N-acetyl-4-benzoquinonoimine (NAPQI). It has been established that this is a highly potent oxidant, reacting with the thiol [-SH] groups in reduced glutathione.

In the case of paracetamol, it is responsible for the development of severe liver damage, as well as damage to the kidneys, liver, heart, pancreas and other secondary organs. [26]

Excessive intake of paracetamol can result in the occurrence of acute hepatic necrosis, a condition characterised by the depletion of glutathione and the binding of excess reactive metabolites to vital cell components. It has been demonstrated that this damage can be prevented by early administration of sulfhydryl compounds such as methionine and N-acetylcysteine. [25]

The majority of patients who overdose on paracetamol will initially be asymptomatic, as clinical signs of end-organ toxicity do not appear until 24-48 hours after acute ingestion. Consequently, in order to identify a patient who may be at risk of hepatotoxicity, it is essential for the physician to determine the time of ingestion, amount and preparation of paracetamol.[27]

The course of paracetamol poisoning is characterised by four distinct phases. [26, 28] Phase I (0-24 hours): The following symptoms may be observed: malaise, impaired consciousness without loss of consciousness, nausea, vomiting, abdominal pain and weakness. In some patients, this period may be asymptomatic. Phase II (24-72 hours): A decrease in the patient's clinical symptoms may be observed. Aminotransferases and bilirubin may increase, and prolongation of the international normalised ratio (INR) may occur, along with symptoms of haemorrhagic diathesis. Phase II (24-72 hours) - symptoms may include: malaise, impaired consciousness without loss of consciousness, nausea, vomiting, abdominal pain and weakness. In some patients, this period may be asymptomatic. Phase III (72-96 hours) - the patient's clinical symptoms may decrease. Aminotransferases and bilirubin rise, prolongation of INR (international normalised ratio) - along with symptoms of haemorrhagic diathesis. There is also an increase in serum levels of LDH (lactate dehydrogenase), jaundice and pruritus, and gradually disturbances of consciousness appear. Phase IV (96- 2-4 weeks) - full-blown liver failure develops with symptoms of secondary damage to other organs. These symptoms include: jaundice increases, metabolic acidosis, worsening of consciousness, increased jaundice, metabolic acidosis and consciousness disturbances.[29-31]

Treatment of paracetamol poisoning

In cases where a patient has ingested a dose of paracetamol greater than 75 mg/kg body weight within a time frame of less than one hour, or in instances where the precise dose is unknown, hospitalization should be considered. An indication for hospitalisation is also present in cases of intentional overdose as part of a suicide attempt, regardless of the declared dose. Furthermore, hospitalisation is recommended in instances of drug toxicity, when the

drug is taken in multiple doses over an extended period, or when multiple supratherapeutic doses are taken in a 24-hour period, collectively exceeding 75 mg/kg body weight. [29]

A single dose of activated charcoal may be considered in patients who are alert and able to control their airway and who report rapidly - ideally within 1 hour - after ingestion. This time frame may be extended if the patient has taken an extended-release acetaminophen-based medication or if the ingestion includes agents known to slow gastric emptying, such as opioids. Patients with paracetamol concentrations below the 'possible' line of hepatotoxicity on the Rumack-Matthew nomogram may be discharged home with medical clearance. [27]

The antidote for paracetamol poisoning is N-acetylcysteine. Despite the risk of a non-allergic anaphylactic reaction, NAC administration should not be abandoned when absolutely indicated, even if adverse effects occur. The decision to administer NAC within the first 24 hours after poisoning is based on the interpretation of the paracetamol concentration according to a nomogram. NAC treatment should be started immediately if the measured value is at or above the curve and in patients presenting more than 24 hours after intoxication or if the timing of the toxic dose is unknown. [29]

Intentional drug poisoning in children and adolescents very rarely results in serious illness or death. In the 2022 analysis from Lublin, only 5.8 per cent of cases were admitted to hospital in a serious condition and there were no deaths. [9]

Mental illness in children who have attempted suicide

It is also worth mentioning the quantitative proportion of children with mental illness among those who attempted suicide with medication. This group accounts for 59.1 per cent of the cases and mainly refers to patients with depressive disorders. In the Krakow study (2023), psychological consultation was provided in 74.2% of cases and psychiatric consultation in 75.8%. 11.7% of hospitalisations were for people with somatic chronic diseases: epilepsy, celiac disease, deafness, obesity, hypothyroidism, asthma, psoriasis, recurrent syncope, heart problems, among others. [5]

The COVID-19 pandemic is described as a very stressful time for adults, but also for adolescents [32]. A number of factors have been identified as contributing to pandemic-related stress, including concerns regarding SARS-CoV-2 infection, financial instability within households, challenges related to social or educational environments, and suboptimal physical living conditions. A preponderance of studies has demonstrated an association between pandemic-related stressors and psychopathology, characterised by heightened internalisation and externalisation of psychopathology. [33]

It has been observed that the prevalence of mental health problems in adolescents during the pandemic increased significantly compared to pre-pandemic estimates. [34,35]

Summary and conclusions

The observations and conclusions from the analysis presented suggest the need for increased mental health education for children, adolescents, parents and teachers. The data presented show that the problem of suicide attempts with medication is steadily increasing in the age group of children and adolescents. It can be concluded that the pandemic and associated social isolation have contributed to an increase in suicide attempts, the effects of which will be felt for years to come. All the studies cited have shown the predominance of drug poisoning in the female group and the continued predominance for more than 10 years of the most commonly used substance in overdoses, paracetamol. There are specific methods for treating poisoning with this drug and, if taken promptly, there is a good chance of a complete cure for the patient. This makes it all the more important to increase the awareness and vigilance of parents and teachers and to update their knowledge of mental health, symptoms of mental illness and symptoms of drug poisoning. Long-term psychological support for adolescents and classes that teach children how to solve difficult problems and where to go when they arise are also needed.

Author's contribution:

Conceptualization, Maria Kubicka, Paulina Polańska

methodology, Maria Kubicka

software, Marta Gruszka

check, Paulina Polańska, Marta Gruszka

formal analysis, Paulina Polańska, Martyna Zakrocka

investigation, Maria Kubicka, Martyna Zakrocka

resources, Maria Kubicka

data curation, Marta Gruszka

writing - rough preparation, Maria Kubicka

writing - review and editing, Paulina Polańska; Martyna Zakrocka

visualization, Marta Gruszka

supervision, Martyna Zakrocka

project administration, Maria Kubicka

All authors have read and agreed with the published version of the manuscript.

Funding Statement

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Acknowledgments

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

BIBLIOGRAPHY:

[1] Gumprecht K. Zatrucia. Wybrane zagadnienia z intensywnej terapii dziecięcej. 2nd ed. Śląski Uniwersytet Medyczny w Katowicach. 2011;105

[2] Suchecka D, Kucharska-Mazur J, Groszewska K, Mak M, Samochowiec J, Samochowiec A. Analysis of the phenomenon of over-the-counter drug abuse and not controlled herbs trade by polish adolescents: Part I. *Med Pr*. 2017;68(3):413-422. https://doi.org/10.13075/mp.5893.00245

[3] Meszaros-Tutak A. Leki stosowane w przeziębieniu. Przewodnik Lekarza/Guide for GPs. 2001;18-21.

[4] Tomaszek L, Soń M. Przyczyny występowania zatruć u pacjentów leczonych na oddziale toksykologii. State and Society XXII: 2022, 1. https://doi.org/10.48269/2451-0858-pis-2022-1-006

[5] Tomaszek L, Kurleto P, Turkanik E, Bielec E, Milaniak I, Dąbrowska-Mędrzycka W. Demographic and clinical profile of adolescents suicide attempters admitted to an emergency department during the COVID-19 pandemic - a retrospective cohort study using hospital information system. *Front Psychiatry*. 2024;15:1422008. Published 2024 Jun 17. https://doi.org/10.3389/fpsyt.2024.1422008

[6] Jackowska T, Grzelczyk-Wielgórska M. Acute poisoning as a cause of hospitalization of children and adolescents in the pediatric ward – 9-year analysis. Borgis - Advances in Medical Sciences 92014; 628-632

[7] Portal gov.pl. Suicidal behaviour among children and young people. Report for 2012-2021 based on data from the National Police Headquarters. 2022. https://www.gov.pl/attachment/82261ed5-8c47-4ab7-9241-18fca8ea75ab (Access: 03.01.2025)

[8] Milewska E. Epidemiological situation of acute poisonings of children aged 9-18 years hospitalized in the Suwałki Regional Hospital in 2013-2018. Retrospective analysis. Repository of Medical University of Bialystok. 2019

[9] Sosnowska W. Brzozowska A. Analysis of poisonings in patients up to 18 years old hospitalized in the Clinical Department of Toxicology and Cardiology in Stefan Wyszyński Regional Specialist Hospital in Lublin in 2022. Journal of Education Health and Sport 14(1):79-89 https://doi.org/10.12775/JEHS.2023.14.01.009

[10] Farah R, Rege SV, Cole RJ, Holstege CP. Suspected Suicide Attempts by Self-Poisoning Among Persons Aged 10–19 Years During the COVID-19 Pandemic — United States, 2020–2022. MMWR Morb Mortal Wkly Rep 2023;72:426–430. http://dx.doi.org/10.15585/mmwr.mm7216a3

[11] Mayo Clinic. COVID-19 and your mental health. 2024. https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/mental-health-covid-19/art-20482731?utm_source=chatgpt.com (Access: 02.01.2025)

[12] Penna A, Buchanan N. Paracetamol poisoning in children and hepatotoxicity. *Br J Clin Pharmacol*. 1991;32(2):143-149. https://doi.org/10.1111/j.1365-2125.1991.tb03873.x

[13] Verbić A. Paracetamol poisoning in children. Medicina Fluminensis. 2016. 52(4). https://doi.org/10.21860/medflum2016_4ver

[14] Uwumiro F, Okpujie V, Olaomi OA, et al. Profile of Childhood Poisoning and Its Outcomes in the United States: A One-Year Nationwide Study of Emergency and Inpatient Admissions. *Cureus*. 2023;15(4):e37452. Published 2023 Apr 11. https://doi.org/10.7759/cureus.37452

[15] Pilarska I, Grabska K, Stachurski J. Suicide attempts among children and adolescents admitted to a Polish Emergency Department: Analysis of epidemiology, circumstances and methods of 154 cases. *Adv Clin Exp Med*. 2023;32(12):1377-1384. https://doi.org/10.17219/acem/162245

[16] Błaszczak, Jan. 2011. „Farmakokinetyka, metabolizm i hepatotoksyczność paracetamolu po narażeniu pojedynczym i łączonym z trichloroetylenem i N-acetylocysteiną". http://www.wbc.poznan.pl/Content/220045/PDF/index.pdf. (Access: 3.01.2025)

[17] Dart RC, Mullins ME, Matoushek T, et al. Management of Acetaminophen Poisoning in the US and Canada: A Consensus Statement [published correction appears in JAMA Netw Open. 2023 Sep 5;6(9):e2337926. doi: 10.1001/jamanetworkopen.2023.37926]. *JAMA Netw Open*. 2023;6(8):e2327739. Published 2023 Aug 1. https://doi.org/10.1001/jamanetworkopen.2023.27739

[18] Chiew AL, Reith D, Pomerleau A, et al. Updated guidelines for the management of paracetamol poisoning in Australia and New Zealand. *Med J Aust*. 2020;212(4):175-183. https://doi.org/10.5694/mja2.50428

[19] Kostowski W, Herman Z(red.). Pharmacology. PZWL 2010;1(2);225-228

[20] Panasiuk L, Król M, Szponar E, Szponar J. Acute poisoning. General Practice. 1st ed. PZWL. 2010;59-61

[21] Burchell B, Soars M, Monaghan G, Cassidy A, Smith D, Ethell B. Drug-mediated toxicity caused by genetic deficiency of UDP-glucuronosyltransferases. *Toxicol Lett*. 2000;112-113:333-340. https://doi.org/10.1016/s0378-4274(99)00209-x

[22] Prescott LF. Paracetamol: past, present, and future. Am J Ther. 2000;7:143-147.

[23] Zhou S, Chan E, Duan W, Huang M, Chen YZ. Drug bioactivation, covalent binding to target proteins and toxicity relevance. *Drug Metab Rev*. 2005;37(1):41-213. https://doi.org/10.1081/dmr-200028812

[24] Craig DG, Ford AC, Hayes PC, Simpson KJ. Systematic review: prognostic tests of paracetamol-induced acute liver failure. *Aliment Pharmacol Ther*. 2010;31(10):1064-1076. https://doi.org/10.1111/j.1365-2036.2010.04279.x

[25] Forrest JA, Clements JA, Prescott LF. Clinical pharmacokinetics of paracetamol. *Clin Pharmacokinet*. 1982;7(2):93-107. https://doi.org/10.2165/00003088-198207020-00001

[26] Hinz-Brylew N, Rajewski P. Acute paracetamol poisoning — three cases description Acute paracetamol poisoning— three cases description. Forum Medycyny Rodzinnej 2011;5(5):429–433

[27] Medscape - Drugs&Diseases / Emergency Medicine / Acetaminophen Toxicity Clinical Presentation https://emedicine.medscape.com/article/820200-clinical?form=fpf (Access: 3.01.2025)

[28] Prescott LF. Kinetics and metabolism of paracetamol and phenacetin. Br J Clin Pharmacol. 1980 Oct;10 Suppl 2(Suppl 2):291S-298S. doi: 10.1111/j.1365-2125.1980.tb01812.x. PMID: 7002186; PMCID: PMC1430174.

[29] Szczeklik A. Choroby wewnętrzne. 2010. Medycyna Praktyczna. 2010; 1017–1020, 2295–2296.

[30] Sen S, Mookerjee RP, Davies NA, Williams R, Jalan R. Review article: the molecular adsorbents recirculating system (MARS) in liver failure. *Aliment Pharmacol Ther*. 2002;16 Suppl 5:32-38. https://doi.org/10.1046/j.1365-2036.16.s5.5.x

[31] Prescott LF. Paracetamol, alcohol and the liver. *Br J Clin Pharmacol*. 2000;49(4):291-301. https://doi.org/10.1046/j.1365-2125.2000.00167.x

[32] Goldman-Mellor S, Allen K, Kaplan MS. Rural/Urban Disparities in Adolescent Nonfatal Suicidal Ideation and Suicide Attempt: A Population-Based Study. *Suicide Life Threat Behav*. 2018;48(6):709-719. https://doi.org/10.1111/sltb.12390

[33] Rosen ML, Rodman AM, Kasparek SW, et al. Promoting youth mental health during the COVID-19 pandemic: A longitudinal study. *PLoS One*. 2021;16(8):e0255294. Published 2021 Aug 11. https://doi.org/10.1371/journal.pone.0255294

[34] Kang S, Jeong Y, Park EH, Hwang SS. The Impact of Household Economic Deterioration Caused by the COVID-19 Pandemic and Socioeconomic Status on Suicidal Behaviors in Adolescents: A Cross-sectional Study Using 2020 Korea Youth Risk Behavior Web-based Survey Data. J Prev Med Public Health. 2022 Sep;55(5):455-463. https://doi.org/10.3961/jpmph.22.241

[35] Agostino H, Burstein B, Moubayed D, et al. Trends in the Incidence of New-Onset Anorexia Nervosa and Atypical Anorexia Nervosa Among Youth During the COVID-19 Pandemic in Canada. *JAMA Netw Open*. 2021;4(12):e2137395. Published 2021 Dec 1. https://doi.org/10.1001/jamanetworkopen.2021.37395