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Epidemiology of lice among Polish youth — 5-year follow-up based on sales data in stationary pharmacies

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ABSTRACT

The study aimed to analyse the severity of lice epidemics in annual cycles in 2019–2023, based on the sales figures of anti-lice preparations throughout Poland in stationary pharmacies. The study included a 5-year retrospective analysis of the sale of anti-lice products in a nationwide sample of pharmacies. The analysis period includes sales from 1.01.2019 to 31.12.2023. This study was obtained from a nationwide sample of stationary pharmacies. The data analysed are representative at the national level and were carried out on a sample of approximately 6500 pharmacies (over 50% of all existing pharmacies). In the years 2019–2023, 5.16 million (Mean 1.42; SD 0.41) anti-lice preparations were sold. Proportions of sales of anti-lice products considering the product category breakdown were patches, rubber bands 3.4%, aerosol liquids 56%, and shampoos 40.6%. The analysis showed an increased demand for anti-lice agents in September–October. The number of purchased anti-lice products is growing in higher-income voivodeships, which may be related to greater awareness and preventive measures of this part of the Polish population. The period of increased demand for lice preparations is related to the school calendar and increases after school children return to their classes after long breaks (holidays).

Keywords: lice infestation, school youth, prevention of lice, pharmacy sales

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Introduction

Lice is a parasitic disease, which is a serious social and medical problem in many European countries, regardless of the level of development and affluence of a given society. Lice are believed to be among the earliest human parasites and have been found in records from antiquity, as well as in Egyptian mummies, bodies from excavations in South America, Northern Europe (Vikings) and many others. The etiological factor of lice are arthropods belonging to the species *Pediculus humanus*, within which it is possible to distinguish Parasitic species of clothing louse (*Pediculus humanus corporis*) and head louse (*Pediculus humanus capitis*). Adults of the species *P. humanus*, maggots and/or eggs may be found on the human body. Depending on the causative factor and the location of the parasite, the most common are head lice (*pediculosis capitis*), pubic

lice (*pediculosis pubis*) and clothing lice (*pediculosis corporis*). The head louse feeds on human blood. Parasitizing on the host's skin, causes bites, which then cause papulous-oedematous rash on the skin — these lesions, unfortunately, can be irritating and itchy. Larger groups of people make it easy to transmit the parasite. Lice infestation manifests itself as annoying itching of the scalp, which results in micro-damage to the scalp as a result of scratching. The ailments mainly affect children, but to a lesser extent also adults, as a secondary transmission from children (exposure at school, kindergarten, nursery) to caregivers [1].

Ineffective treatment of lice causes health consequences in two spheres:

- individual,
- transmission to other people.

Rapid implementation of effective lice control is essential. Pharmacies offer a large range of suitable

medicines and cosmetics. Lice infestation requires the use of agents that are effective not only against lice, but also maggots (eggs), and at the same time are harmless to the patient, especially in the age group of children. The agents are split into 2 main categories:

- biocidal effect,
- deterrent effect [2].

The preparations in the first group are shampoos, lotions and sprays. These preparations cannot irritate the scalp or cause allergic reactions, so the mechanism of their action is based on their insulating effect, i.e. tight covering of adult parasites and their eggs, which cuts off the oxygen supply and disturbs gas exchange. The second group is treated as prevention, the task of these preparations is to deter. These are rubber bands, lotions, and patches soaked in oils (fragrances) that repel parasites from the hair and scalp. Active substances in the form of oils are dedicated to various parasites — there are separate for lice, separate for mosquitoes, ticks, and in addition, manufacturers guarantee two criteria:

- safety for children
- reusability (they stay active after a cycle of several washes).

In addition, as a preventive measure, it is necessary to take care of scalp hygiene, frequently inspect children's hair, and comb it out with a special comb [3].

Prevention of lice infestation among children should be carried out in two ways: by parents/guardians at home, and in accordance with the regulations in educational institutions (kindergartens, schools). Preventive measures against the spread of lice include periodic head inspections (medical staff at school, parents at home). In addition, what is needed is observation of children (for itching of the head, scratch marks, and signs of swollen lymph nodes), and teaching personal hygiene habits (regular washing of the head) [4, 5].

The problem of lice infestation affects several educational institutions and the problem itself occurs cyclically. Children are most often exposed at the age of 3–12. The cause of transmission is direct contact (playing, sharing objects), and lack of consistency in hygiene habits. In society, the phenomenon is treated as an embarrassing problem, and consequently, such an approach results in lower effectiveness in combating the parasite epidemic. Educational entities should provide the right conditions for safe and hygienic education of children. Outside schools, the problem concerns care facilities where children stay all the time [6].

Objective

The study aimed to analyse the severity of lice epidemics in annual cycles in 2019–2023, based on the sales figures of anti-lice preparations throughout Poland in stationary pharmacies. In addition, the authors defined the research hypothesis by stating that the sales of anti-lice preparations are influenced by the cycle of education, including longer breaks from school in the summer months (summer holidays) and winter months (winter holidays).

Materials and methods

The study included a 5-year retrospective analysis of the sale of anti-lice products in a nationwide sample of pharmacies. The analysis period includes sales from 1.01.2019 to 31.12.2023.

The data in this study were obtained from a nationwide sample of stationary pharmacies. The data analysed are representative at the national level and were carried out on a sample of approximately 6500 pharmacies (over 50% of all existing pharmacies). Data were extrapolated based on a representative, nationwide panel of approx. 6500 pharmacies (out of approx. 12,600 operating ones). The data validation was performed in relation to the data set from the National Health Fund (NHF) for reimbursed drugs (total), where 99% compliance was achieved.

The data obtained from a sample of 6500 pharmacies were also correlated with statistical data of the Central Statistical Office (CSO) concerning all pharmacies and pharmacy outlets in Poland, with a breakdown of pharmacies in individual voivodeships.

Ethical considerations

The analysis does not reveal any sensitive data, concerning patients, medical staff, pharmacy staff, or financial data (turnover, income). The consent of the President of the Management Board of the PEX Sp. z o.o. pharmacy chain was obtained in September 2023, after which the authors received the data at the beginning of February 2024, when the statements for the entire 2023 were already available. The data are fully anonymous, the analysis complies with the principles of the Declaration of Helsinki and did not require the consent of the bioethics committee.

Data collection

The authors received sales data in the form of a Microsoft Excel database. The data included sales figures for anti-lice preparations, taking into account:

- 2019–2023 coverage with complete annual sales,
 - the share of Polish regions (voivodships) in nationwide sales,
 - preparations breakdown into specific categories: shampoos, lotions and aerosols, and rubber bands.
- The data take into account the following variables:
- the number of packages sold — pharmacy market only,
 - SU (standard units) — a standardized amount of preparation: e.g. tablets, “sips of liquid preparations”, “aerosol doses (sprays)”, “drops”. The assumed measure eliminates the problem of sales differentiation resulting from changes in the structure of different package sizes purchased by patients.

Statistical analysis

The database was prepared in Microsoft Excel using MS Office 2016 for Windows 10. Descriptive statistics were used to characterize the variables. The following measures were calculated for the variables: total number (n), share %, mean (M), and standard deviation

(SD). A two-sided value of $p < 0.05$ was considered statistically significant for all the null hypotheses tested. All statistical calculations were performed using STATISTICA software version 13.3 (TIBCO Software, Palo Alto, California, USA).

Results

In the years 2019–2023, 5.16 million (Mean 1.42; SD 0.41) anti-lice preparations were sold in the group of pharmacies under observation: 2019 — 1.59 million, 2020 — 1.04 million, 2021 — 0.98 million, 2022 — 1.54 million, 2023 — 1.98 million.

Tables 1 and 2 present sales data for the whole of Poland, detailing the voivodships.

The statistical analysis showed statistically significant differences ($p = 0.001$) in the sales of preparations in the analysed period, in relation to both the entire country (Table 1) and individual voivodships (Table 2).

Moreover, the number of preparations sold in a given year was analysed and correlated with the number of children in kindergartens and schools. These data are included in Table 2 and Figure 1.

Sales data based on annual average values (2019–2023) for the entire country and the Dolnoslaskie Voivodship (random selection) are presented in Figure 2.

Table 1. Number of preparations sold by voivodship

Year	2019	2020	2021	2022	2023	p
Lower Silesian	10857 ± 3872	6922 ± 3046	6380 ± 2391	9379 ± 2976	12324 ± 4377	0.001
Kuyavian-Pomeranian	7483 ± 2686	5104 ± 2080	4819 ± 1781	6855 ± 2350	9128 ± 3281	0.001
Łódź	8384 ± 2621	5889 ± 2490	5752 ± 2135	8878 ± 3041	11309 ± 3469	0.001
Lublin	5799 ± 2135	3762 ± 1511	3441 ± 1258	6642 ± 2668	8458 ± 2665	0.001
Lubuskie	3424 ± 1103	2388 ± 827	2576 ± 946	3731 ± 1190	4331 ± 1300	0.001
Lesser Poland	11299 ± 4018	6751 ± 2800	6554 ± 2708	12035 ± 4644	15747 ± 4701	0.001
Masovian	21457 ± 7389	13679 ± 6348	12279 ± 4637	21210 ± 7918	28323 ± 10106	0.001
Opole	3256 ± 1115	1955 ± 840	1812 ± 687	2608 ± 980	3655 ± 1375	0.001
Subcarpathian	3845 ± 1385	2398 ± 978	2201 ± 889	3724 ± 1376	5266 ± 2024	0.001
Podlaskie	3213 ± 938	2136 ± 790	2049 ± 876	3268 ± 1176	4104 ± 1265	0.001
Pomeranian	8585 ± 2677	5874 ± 2135	5835 ± 2173	8963 ± 3104	11521 ± 3677	0.001
Silesian	17277 ± 5993	11496 ± 4750	10764 ± 3840	15880 ± 5402	18603 ± 5694	0.001
Świętokrzyskie	2608 ± 848	1578 ± 645	1466 ± 617	2335 ± 865	2993 ± 1065	0.001
Warmian-Masurian	4675 ± 1468	3270 ± 1326	3039 ± 1117	4360 ± 1401	5388 ± 1883	0.001
Greater Poland	14607 ± 5054	9624 ± 3924	8902 ± 3445	13135 ± 4897	16978 ± 6109	0.001
West Pom.	6242 ± 1922	4220 ± 1518	4450 ± 1735	6425 ± 1932	7225 ± 2031	0.001
Whole Poland	133th ± 44.5th	87th ± 45.8th	82th ± 43.0th	129th ± 44.9 th	155th ± 52.3th	

th — thousands

Table 2. Calculated ratio of the number of preparations sold per 100 children, with regional (voivodeship) breakdown

Year	2019	2020	2021	2022	2023
Lower Silesian	2.35 ± 0.84	1.50 ± 0.66	1.38 ± 0.52	2.03 ± 0.64	2.66 ± 0.95
Kuyavian-Pomeranian	2.27 ± 0.81	1.55 ± 0.63	1.46 ± 0.54	2.08 ± 0.71	2.77 ± 1.00
Łódź	2.20 ± 0.69	1.54 ± 0.65	1.51 ± 0.56	2.33 ± 0.80	2.96 ± 0.91
Lublin	1.76 ± 0.65	1.14 ± 0.46	1.05 ± 0.38	2.02 ± 0.81	2.57 ± 0.81
Lubuskie	2.05 ± 0.66	1.43 ± 0.50	1.55 ± 0.57	2.24 ± 0.71	2.60 ± 0.78
Lesser Poland	1.87 ± 0.66	1.12 ± 0.46	1.08 ± 0.45	1.99 ± 0.77	2.61 ± 0.78
Masovian	2.14 ± 0.74	1.36 ± 0.63	1.23 ± 0.46	2.12 ± 0.79	2.83 ± 1.01
Opole	2.26 ± 0.77	1.36 ± 0.58	1.26 ± 0.48	1.81 ± 0.68	2.54 ± 0.95
Subcarpathian	1.11 ± 0.40	0.69 ± 0.28	0.63 ± 0.26	1.07 ± 0.40	1.52 ± 0.58
Podlaskie	1.72 ± 0.50	1.15 ± 0.42	1.10 ± 0.47	1.75 ± 0.63	2.20 ± 0.68
Pomeranian	2.02 ± 0.63	1.39 ± 0.50	1.38 ± 0.51	2.11 ± 0.73	2.72 ± 0.87
Silesian	2.44 ± 0.85	1.62 ± 0.67	1.52 ± 0.54	2.24 ± 0.76	2.63 ± 0.80
Świętokrzyskie	1.45 ± 0.47	0.88 ± 0.36	0.81 ± 0.34	1.30 ± 0.48	1.66 ± 0.59
Warmian-Masurian	2.12 ± 0.66	1.48 ± 0.60	1.38 ± 0.51	1.97 ± 0.63	2.44 ± 0.85
Greater Poland	2.31 ± 0.80	1.52 ± 0.62	1.41 ± 0.54	2.07 ± 0.77	2.68 ± 0.96
West Pom.	2.41 ± 0.74	1.63 ± 0.59	1.72 ± 0.67	2.48 ± 0.75	2.79 ± 0.78
Whole Poland	2.03 ± 0.36	1.42 ± 0.43	1.28 ± 0.29	1.87 ± 0.36	2.44 ± 0.38

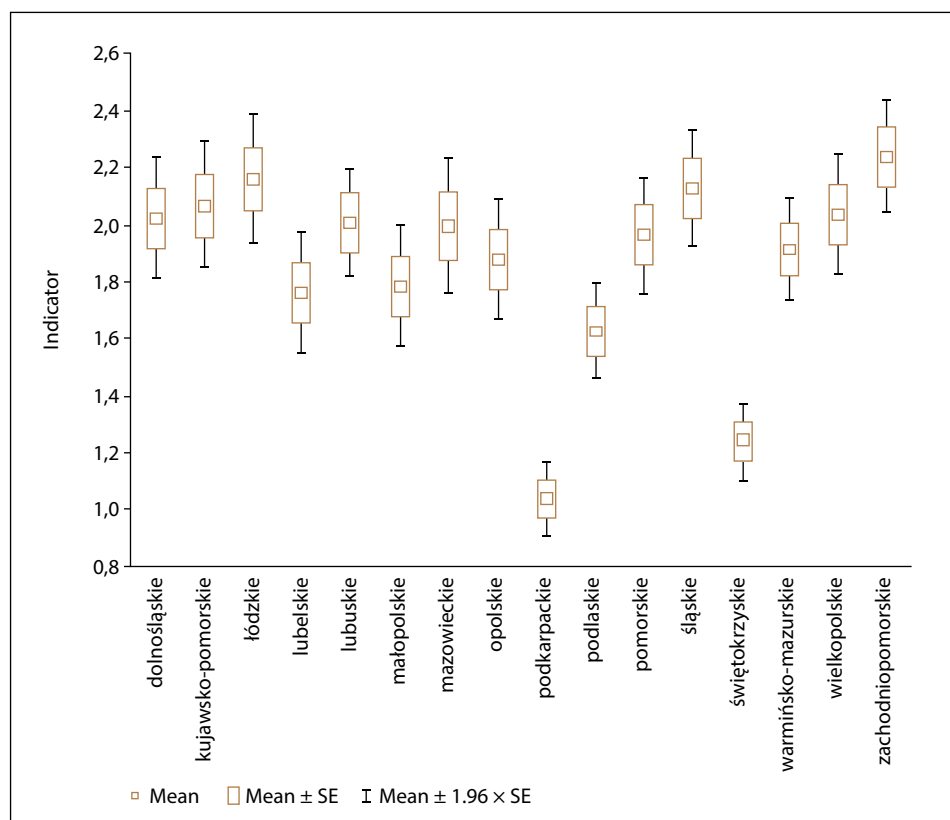


Figure 1. Number of preparations sold per 100 children by region

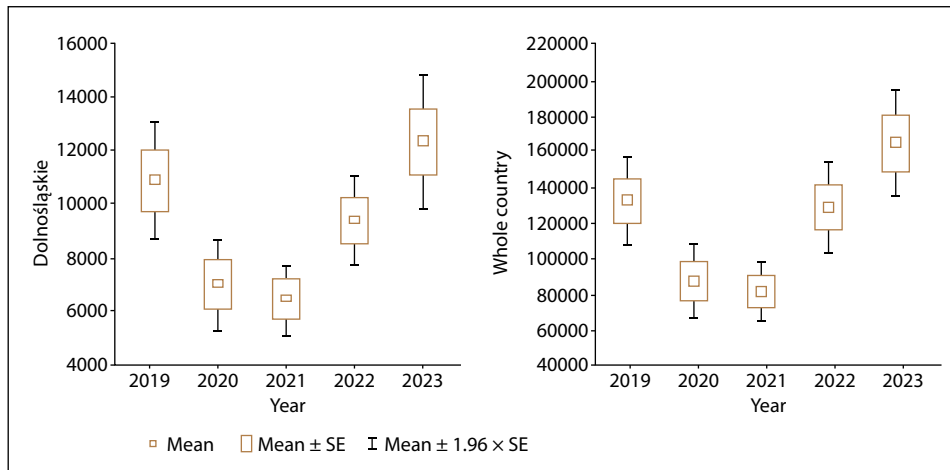


Figure 2. Characteristics of sales of anti-lice products for the whole of Poland and one randomly selected region

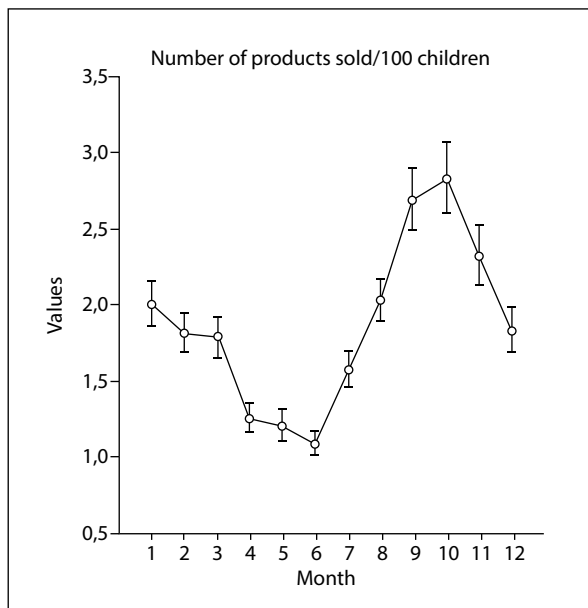


Figure 3. Average monthly sales using the indicator per 100 children

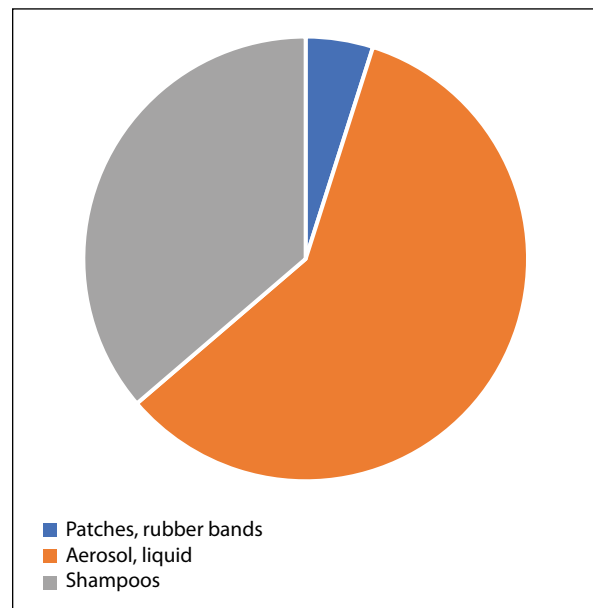


Figure 4. Proportions of sales of anti-lice products taking into account the product category breakdown

Reduced demand is noticeable in the years of the COVID-19 epidemic (2020–2021) both for the entire country and a randomly selected region.

The analysis of monthly sales (Fig. 3) presented as a monthly average for 5 years of observation showed that after returning from summer holidays (September and October) there is an increased demand for the purchase of anti-lice products in pharmacies.

Sales were also analysed taking into account specific product groups. The distribution is graphically presented in Figure 4:

- patches, rubber bands 3.4%,
- aerosol liquids 56%,
- shampoos 40.6%.

Another variable that was covered by the observation was income (affluence) with voivodeship breakdown, calculated as annual averages. The results are presented in Figure 5.

The correlation graph shows the relationship between the rate of preparations sold per 100 children for a given voivodeship and the average annual income for a given voivodeship during the observation period, i.e. in

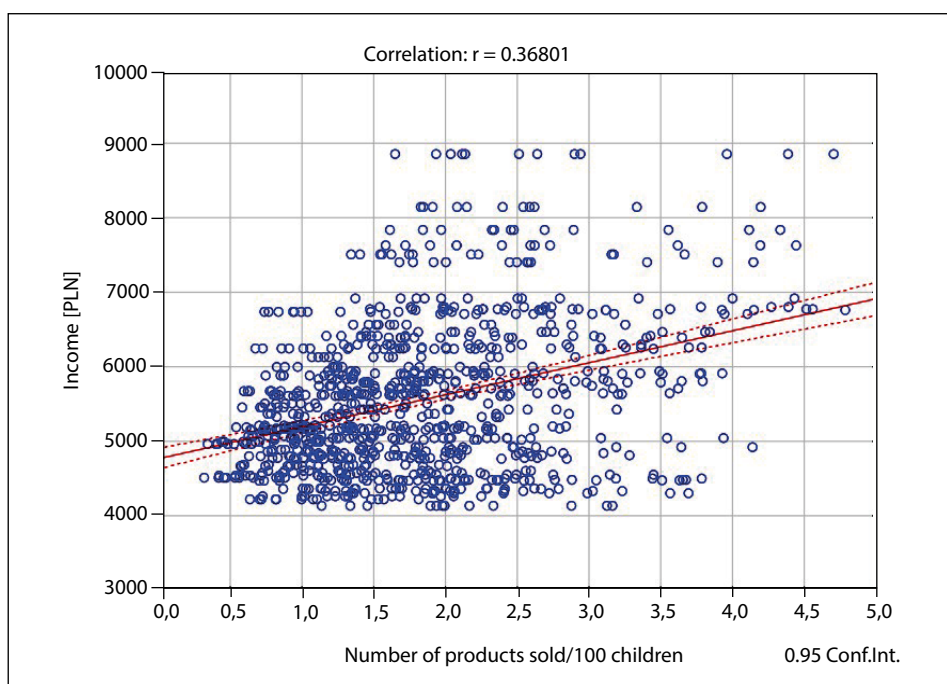


Figure 5. Simple linear regression analysis (Pearson) between income [PLN] and number of products sold per 100 children

2019–2023 ($R = 0.368$; $p < 0.001$). This is a statistically significant correlation indicating that on a national scale, the ratio of preparations sold per 100 children increases quite significantly as income increases.

Discussion

Lice can be a vector (as a carrier) of dangerous pathogenic microorganisms. This mechanism is similar to exposure to tick bites and the transmission of dangerous diseases by them. The threat in humans is generated by 3 groups of lice: head, pubic and clothing lice [7].

Gregorowicz-Warpas emphasizes that there is a common misconception that the occurrence of lice is associated with dirt and lack of hygiene. As a result, in many countries, including Poland, lice infestation is a taboo subject. On the other hand, numerous studies indicate that it occurs all over the world, in different climatic zones and countries with different levels of affluence. Transmission is facilitated by large groups of people, not only schools or public transport but also hospitals and hotels. Another myth to which the author refers is the location of lice only on the hairy scalp. In countries where depilation is fashionable or a person does not have hair on the head, pubic lice also inhabit the beard, moustache, eyebrows and armpit hair [8]. The present study regarding the purchases of pharmaceutical and prophylactic agents did not specify the

division of preparations as per the specific type and location of head lice.

Bartosik et al. point to the low effectiveness or lack of screening programs, which contributes to the marginalization of the problem. A survey that covered Polish schools showed that lice campaigns were carried out mainly in connection with the appearance of lice, and most schools could not count on institutional support. The authors' work aimed to investigate the prevalence of head lice among primary school children in villages and towns in eastern Poland, one of the poorest regions of the European Union. The study was conducted in 2009–2012 in 30 rural and urban state schools and compared with the research carried out in previous years (1996–2000). These authors showed that lice were diagnosed in 2.01% of students, more often in students from rural areas (3.52%) than in students attending urban schools (0.98%). Lice were more common in girls (59.52%) than in boys (40.48%). The risk of lice infestation in children increased in schools without a nurse (mean 5.07%), it decreased with nurses working part-time (mean 2.96%), while it was the lowest with nurses employed full-time (mean 1.01%). The authors also showed that the incidence of lice doubled, despite the improvement in the socioeconomic situation of the population observed over 16 years [9]. The methodology of self-examination cannot serve to confirm whether state aid in the sphere of control or prevention against lice is sufficient, but a large number of preparations

purchased each year indicates the widespread problem throughout Poland [9].

Meiser et al. with recourse to a literature review investigated the available treatments.

The authors confirm the majority of scientific reports indicating that transmission most often occurs through direct contact. Importantly, the study shows that resistance to pediculicides occurs in pharmacological treatment. To break the chain of transmission, drugs should be used that act not only on living individuals but also on eggs. The observed purchase of pharmaceuticals in the author's study concerned all pharmaceutical products, without distinguishing between specific preparations [10].

Deng et al. draw attention to secondary health hazards (bacterial diseases) transmitted by lice. In many countries, diseases that have not been reported for many years reappear in the population of homeless people or prisoners, e.g. due to *Bartonella* and *Borrelia* [11].

Observations by Sangaré et al. based on a literature review provide information on therapeutic and preventive methods. Despite the development of the pharmaceutical industry and modern cosmetic methods, mechanical removal of lice, heating infected clothes and shaving the scalp, as well as the use of numerous insecticides are still considered effective [12].

The technique used in the mechanical method is combing out with a special comb, but since the authors are not talking here of a pharmaceutical preparation, it was not included in the observation in the present study. This method is quite common due to its ease of execution (the comb is specially adapted to combing out maggots), and the low cost of accessories. Various chemical (pharmaceutical, disinfection) and physical methods are used in various countries, such as removing or using extreme temperatures, freezing or immersing objects in boiling water (a common route of transmission is the sharing of headgear, combs, brushes), and methods of electrical impulses [13]. At the same time as the patient is treated, it is necessary to ensure the cleanliness of clothes, bedding, blankets and towels. A complete change of personal underwear and bed linen should be made. Underwear in a tightly closed, labelled bag should be handed over to a laundry, where the procedure for dealing with contaminated underwear will be applied. Clothes, bedding, towels and plush toys should be washed in water at a temperature of 50–60°C or dry cleaned and then ironed with a steam iron (200°C). Drying at high temperatures for at least 30 minutes is also effective. Disinfection of clothes must be carried out with particular attention to the seams. Although washing and ironing with a hot iron/mangling should destroy

the parasites, you should not use previously infected clothing for 2–3 weeks. Headgear, hair ornaments, brushes, combs and stethoscopes should be cleaned and disinfected with a pediculicide or disinfectant (e.g. based on isopropyl alcohol) [8].

Gordon et al. with their observations refer to the present study by describing the most popular preparations currently used, divided into categories: gel, shampoo, and cream, which can be purchased in pharmacies. The authors draw attention to the need to follow the manufacturer's recommendations regarding the proper application of preparations, duration of action and repetition of treatment [14].

In Poland, it is estimated that < 1% of the population is affected by lice, mostly children. The spread of the disease is facilitated by the high density of the population. However, many reports indicate that it occurs worldwide. Rukke cites information about lice in Norway. Households of diverse socio-economic status and family background face the problem, and school-related factors also have an impact in this respect [15].

According to another study, the problem with lice depends to a large extent on the size of the locality, and the scale of the problem is alarming [16].

Dehghanzadeh et al. studied adolescents in the northeastern part of Iran, which resulted in an interesting division of the infected into urban and rural youth and by sex [17]. Further estimates are for the poorer regions of Brazil, where the prevalence of head lice (rural communities and urban slums) ranges from 28% to 43%, respectively. Children are the most affected, often concentrated in schools [18]. In Sweden, there is also an increased annual average number of anti-lice preparations sold, which may be related to greater awareness and preventive measures [19].

Reports on the problem of the spread of lice also concern highly developed countries: Belgium (10% children), the Czech Republic (14%), and the USA (9 million people). In Poland, lice transmission statistics mainly concern large cities [20].

Observations of social groups other than school youth were conducted by Tytuła et al. Data on the occurrence of lice and scabies come from three centres for foreigners in Poland from 2015–2016. The indicated dermatological problems are current worldwide, especially among children. Attention should also be paid to niche national communities, with cultural and religious differences, and different levels of hygiene. In addition, the authors draw attention to the lack of a statutory obligation to employ nurses in care and educational institutions [21]. Moreover, head lice are not included in the list of infectious diseases in the annexe to the

Act on Official Control of Infectious Diseases, which results from statistics that do not include the occurrence of dangerous infectious diseases transmitted by lice. Therefore, there is no obligation to report the occurrence of lice [22]. According to the data presented by Gregorowicz-Warpas for previous years, in 2005, 620 cases of lice were recorded in Poland, in 2006 — 897, and in 2007 — as many as 2261. It should be noted that the statistics provided included only cases reported to the PSSE (District Sanitary and Epidemiological Station), but the actual scale of the problem is much larger. The lack of up-to-date data on the incidence of lice and the number of cases does not mean that there are none. From September 2014 to September 2015, over a million preparations fighting the parasites were purchased in Poland. In one year, the market demand grew by 18%. The upward trend in this respect is also evidenced by data from the Social Insurance Institution — more and more people take sick leave due to lice. In the first half of 2015, the Social Insurance Institution counted 244 days of absence, which is almost as many days as in the whole of 2012 (245 days). For comparison's sake, in 2014, absenteeism was 441 days [8].

The epidemic may be marginalized locally, which spurs transmissions and makes it difficult to implement quick and effective countermeasures. This is particularly important in institutional care centres, where adolescents may not be fully covered by prevention in the same way as adolescents living in their households. Parents are an important link in the control of children's health and hygiene, and they make their own decisions about the purchase of medicinal and prophylactic products in pharmacies to a greater extent than in the population of people under institutional care.

Limitations

The present observation aimed to assess the severity of the lice epidemic among school children. However, the analysed data was divided into measures for children vs. measures for adults. It is possible that adults in some cases also used these measures if their children brought lice home from school.

Conclusions

1. The number of purchased anti-lice products is growing in higher-income voivodeships, which may be related to greater awareness and preventive measures of this part of the Polish population.

2. The period of increased demand for lice preparations is related to the school calendar and increases after school children return to their classes after long breaks (holidays).
3. The COVID-19 period and the change in the mode of education to remote or hybrid is noticeable, in that way that it is linked to reduced potential transmission of lice.

Article information

Author contributions: Łukasz Dudziński — data acquisition, writing, methodology, data analysis, correspondence with the editors, critical comments, acceptance of the final version; Tomasz Kubiak — critical comments, acceptance of the final version; Marcin Weiner — critical comments, acceptance of the final version; Łukasz Czyżewski — critical comments, acceptance of the final version, statistical analysis.

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