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RESEARCH ON THE USE OF MEDICINAL PLANT MATERIALS AND HERBAL-BASED MEDICINES IN THE TREATMENT OF CHILDREN, PREGNANT AND BREASTFEEDING WOMEN

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Plants have been the primary therapeutic agents for humanity for millennia. Parents are increasingly seeking alternative treatments that appear safer to improve their children's health, utilizing Herbal Medicine Substances (HMS).
The aim of the study *was to provide evidence-based information for physicians and the public on the most commonly used medicinal plant materials and herbal remedies for treating children, pregnant women, and breastfeeding mothers, and to assess potential risks.*
Materials and methods. *Data were collected about 713 children under the age of 12, represented by 678 respondents, and 383 of them about pregnancy and 385 women about breastfeeding. The study analyzed information on the herbal remedies used, their frequency of application, indications for use, treatment efficacy, and potential side effects of herbal preparations. The study examined seven specific objects: linden flowers (Tiliae flos), garlic bulbs (Allii sativi bulbus), chamomile flowers (Matricariae flos), calendula flowers (Calendulae flos), aloe leaves (Aloe folium), mint leaves (Menthae piperitae folium), and blueberry fruits (Myrtilli fructus). The analysis of the current state of HMS research was conducted based on data from PubMed, Embase, Best Evidence, EMA, and the British Medical Journal.*
Results*. Within the studied continuum, 81% of children used medicinal plant materials or herb-based preparations. The predominant indications for use were respiratory infections (colds) and digestive disorders. It was established that the use of herbal remedies only partially complied with the recommendations of the European Medicines Agency (EMA). For instance, 54% of children used aloe leaves to treat skin inflammation, which the EMA does not recommend for this age group. The study also revealed the use of medicinal plant materials not recommended by the EMA, specifically coltsfoot leaves, St. John's wort herb, and ginkgo biloba leaves. Side effects were recorded in 2.6% of children, most frequently associated with the use of garlic bulbs and mint leaves. Furthermore, the use of raw materials not recommended during pregnancy and lactation, such as motherwort herb, was identified. The systematized data served as the basis for recommendations for physicians and the public regarding the core criteria of phytotherapy in pediatrics, and for pregnant and breastfeeding women.*
Conclusions*. Since medicinal plant materials and herb-based preparations play a significant role in pediatric treatment, as well as during pregnancy and lactation, and study results indicate the use of products not recommended by the EMA, there is an urgent need to inform physicians and the general public about the correct application of herbal remedies and the potential risks associated with their use*
Keywords*: medicinal plants, herbal treatment, childhood, pregnant women, breastfeeding women, potential risks*

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1. Introduction

The use of Medicinal Plant Raw Materials (MPRM) and herb-based preparations is a growing trend worldwide [1, 2]. There is a constant increase in the consumption of dietary supplements containing natural ingredients [3]. In line with this global trend, the use of natural remedies in children is also on the rise [4, 5]. The general consumption of medicinal plants and other over-the-counter medicines in Estonia has been studied previously [6, 7], but not among children [8, 9].

Parents are increasingly seeking alternative treatments they perceive as safer for improving their children's health, including Herbal Medicine Substances (HMS). According to the World Health Organization (2021) definition, HMS includes herbs, herbal materials, herbal preparations, and finished herbal products that contain parts of plants with active ingredients, other plant materials, or combinations thereof [10]. While the action of synthetic chemical compounds is usually directed at a single target, a plant-derived medicinal product containing multiple active substances simultaneously exhibits a polyvalent (multitarget) effect [11].

The prevalence of herbal medicine use for pediatric diseases varies by country, ranging from 0.8% to 85.5% during childhood [12–14]. Most frequently (80% of respondents), individuals obtain the necessary information regarding herbal remedies from friends and relatives [15].

The most common reasons for using herbal remedies among the pediatric population are immune support and cold prevention. More than two-thirds of the herbal preparations used in children are applied to treat coughs, rhinorrhea, and acute upper respiratory tract infections [13, 16, 17].

According to 2016 statistics from the Institute for Health Development, the highest primary morbidity among Estonian children was observed in the 1–4 age group. The largest share of morbidity was attributed to upper respiratory tract infections (J00-J99) at 40%, while a smaller percentage was represented by certain infectious and parasitic diseases (A00-B99) at 15% [18]. The most common illnesses across all pediatric age groups are colds, characterized by symptoms such as nasal congestion, nasal discharge, sneezing, sore throat, and cough caused by viruses [19], with rhinovirus being the most prevalent [20].

Women frequently use MPRM during pregnancy, believing them to be more natural and, therefore, safer compared to synthetic pharmaceuticals [21]. The use of MPRM during pregnancy and breastfeeding is insufficiently studied, making it difficult to assess its efficacy and potential risks [22, 23].

The safety classification of HMS is complex, as different sources provide varying recommendations based on regional traditions or country-specific characteristics [24]. The general position is that medicinal products should only be used during pregnancy and lactation when the expected benefit outweighs the potential risk. Assessing the risk-benefit ratio is complicated by insufficient safety information [25]. Interactions between herbal medicinal products and conventional drugs can enhance or diminish the pharmacological or toxicological effects of either component [26, 27]. Children and infants (0 to 1.5 years old) are more susceptible to interactions and toxic effects due to their physiological immaturity [12]. Children possess distinct pharmacokinetic and pharmacodynamic profiles; therefore, indications and dosages developed for adults cannot be applied to them [28]. It is also challenging to link potential idiosyncratic side effects to specific HMS [29]. Most toxic effects of herbal medicines can be attributed to poor product quality; for instance, HMS may contain synthetic active substances, pesticides, herbicides, or other contaminants that affect the user's body. On the other hand, the plant itself may contain potent or even poisonous substances, such as alkaloids, furocoumarins, hallucinogenic terpenoids, or cardiac glycosides [30, 31]. Side effects of herbal preparations occur relatively infrequently, and serious adverse effects are very rare [32, 33].

The European Medicines Agency (EMA) categorizes HMS into traditional and well-established (evidence-based) use. The traditional use group includes species for which sufficient evidence from clinical trials is lacking, but there is proof that they have been used safely for at least 30 years (including at least 15 years within the European Union). Furthermore, the use of such MPRM does not require medical supervision. Indications for the evidence-based (well-established) group of HMS are based on scientific research [34].

A wide range of HMS is available in Estonian pharmacies. In terms of sales volume (number of units), the most frequently sold items are chamomile flowers, peppermint leaves, Iceland moss, calendula flowers, raspberry-based remedies, and St. John's wort herb. It is worth noting that the sales of chamomile flowers were several times higher than those of other types of MPRM.

The aim of the study was to obtain sound scientific information for physicians and the general public regarding the most frequently used HMS for treating children, as well as for use during pregnancy and breastfeeding, and to assess potential risks.

2. Planning (methodology) of research

The stages describing the study in this research are shown in Fig. 1.

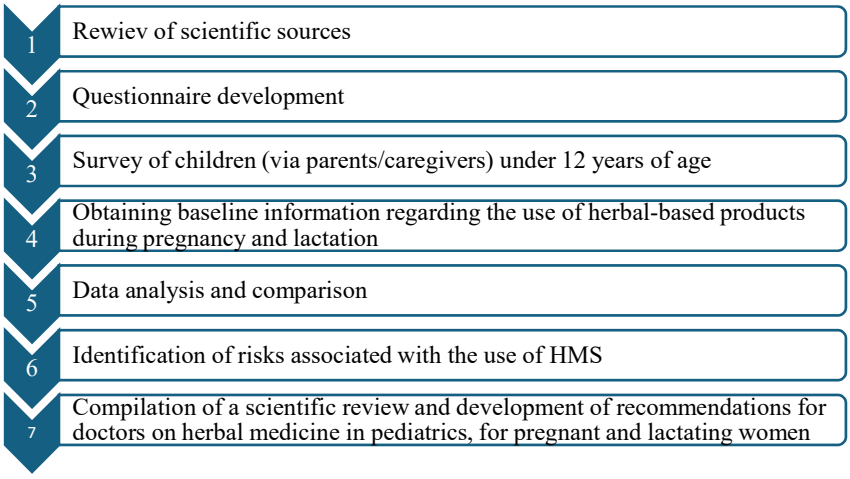

Fig. 1. Planning research

3. Materials and methods

An analysis of the current state of research regarding the use of HMS was conducted using data from the PubMed, Embase, Best Evidence, EMA, and British Medical Journal databases.

Data were collected about 713 children under the age of 12, represented by 678 respondents, and 383 of them about pregnancy and 385 women about breastfeeding. The study was conducted using a written questionnaire method during the period from January to December 2019.

The questionnaires consisted of numbered questions. Most of the questions were multiple-choice, allowing respondents to select multiple answers; where necessary, an "Other" option was included to allow respondents to provide specific details. Two questions assessed the respondents' attitudes toward the safety of herbal remedies using a Likert scale from 1 to 5, where 1 indicated that the respondent "strongly disagreed" and 5 indicated that they "strongly agreed." The developed questionnaire can be obtained from the corresponding author upon request.

The survey was conducted in two parts. The Google Forms platform was utilized for data collection. Preliminary and main surveys were carried out both in paper format and via the social network Facebook.com. A list of 31 medicinal plants was provided as response options, with the option to specify other medicinal plants used. Paper questionnaires were collected in kindergartens, schools, and pharmacies. Online, the survey was primarily shared in child-related social media groups, as well as in groups such as "Traditional Medicine" and "Knowledge." Data collected during the study were entered into Microsoft Excel 2013. Multiple-choice options and "Other..." responses were categorized and coded accordingly. Statistical analysis was performed using Microsoft Excel 2013. Correlation analysis was used to identify age-related dependencies, while the χ^2 test was applied in other cases.

To assess the safety of HMS use, the EMA's recommendations were followed [34]. This study was conducted in accordance with the principles of the Declaration of Helsinki. According to Estonian regulations, ethical approval is not required for anonymous, non-interventional survey studies that do not involve sensitive personal data. Participation in the survey was voluntary, and informed consent was obtained from all participants prior to inclusion in the study. No personally identifiable information was collected.

4. Results

Based on the preliminary results, seven of the most frequently mentioned medicinal plant materials were selected for further investigation, namely: garlic bulbs, mint leaves, chamomile flowers, blueberry fruits, linden flowers, aloe leaves, and calendula flowers (Table 1).

In the main survey, data were collected from 678 respondents regarding 713 children. The questionnaires were gathered from 18 different locations. Through social media, 352 (52%) respondents completed the survey, while 326 (48%) responded via paper questionnaires. Among the respondents, 88% were mothers (n = 597), 7% were grandmothers (n = 46), 4% were fathers (n = 29), and other family members accounted for 0.4% of the participants.

The survey included 47% boys (n = 336) and 48% girls (n = 347). In 25 of 30 cases (5%), the family was reported to have both a boy and a girl. According to the age distribution, the majority were school-age children (47%), followed by toddlers/younger children (29%) and preschoolers (24%). The average age of the children was 6.1 years.

A total of 383 (56%) respondents answered the question regarding the HMS used during pregnancy; of these, 3% stated they did not remember using any. Herbal products were not used by 17% of those surveyed. Among the 80% of respondents who used herbal remedies during pregnancy, 58 types of medicinal plant materials and 12 herb-based medicinal products were utilized, with the 15 most frequently used types listed in Table 2.

In response to the question regarding HMS used during breastfeeding, 385 (57%) women provided data; of these, 16% stated they did not use them. Additionally, 3% of respondents did not recall whether they had used any. Among the 81% who utilized HMS during the breastfeeding period, 62 types of MPRM and 14 preparations were mentioned. Furthermore, vitamins and other natural products, such as propolis and pollen, were also used. Among the medicinal plants, 14 species were most frequently cited, including chamomile, fennel/dill, and peppermint (Table 3).

Table 1

Frequency of HMS use in the treatment of children

MPRM	Users, %
Garlic bulbs	66
Mint leaves	65
Chamomile flowers	55
Blueberry fruits	48
Linden flowers	43
Aloe leaves	41
Calendula flowers	32
Cranberry fruits	29
Fennel fruits	25
Iceland moss thallus	23
Cowslip primrose rhizomes	23
Eucalyptus leaves	22
Plantain leaves	19
Echinacea	17
Tea tree oil	17
Thyme herb (*Serpylli* herba)	15
Thyme herb (*Thymi* herba)	14
Coltsfoot leaves	12
Ivy leaves	12
Caraway fruits	11
Grapefruit seed extract	8
Sage leaves	6
Marshmallow roots	5
Valerian rhizome with roots	5
Bearberry leaves	4
Yarrow herb	1
Sea buckthorn fruits	1
Rosehip fruits	1

Table 2

Most frequently used HMS during pregnancy

Medicinal plant	Users HMS	
	n	%
Chamomile	184	24
Mint	123	16
Linden	71	9
Calendula	55	7
Fennel	42	6
Garlic	35	5
Blueberry	24	3
Wild thyme / Common thyme	19	2
Raspberry	19	2
Aloe	15	2
Nettle	13	2
Caraway	12	2
Blackcurrant	12	2
Ginger	10	1

Table 3

Most frequently mentioned medicinal plants during breastfeeding

Medicinal plant	Users HMS	
	n	%
Chamomile	200	25
Fennel / Dill	123	15
Mint	97	12
Linden	70	9
Calendula	44	5
Garlic	31	4
Caraway	28	3
Blueberry	23	3
Aloe	14	2
Raspberry	11	1
Iceland moss	10	1
Cowslip primrose	10	1
Nettle	9	1
Onion	9	1

5. Discussion

Choosing reliable sources of information.

When selecting treatments for their children, the respondents were divided almost equally between those who trusted the recommendations of a pharmacist or family physician and those who relied on personal experience. Notably, nearly twice as many respondents trusted their personal experience as they did the experience of a relative or close acquaintance (Fig. 2). When making a final decision, they were guided by their own intuition, which aligns with data from other researchers [35].

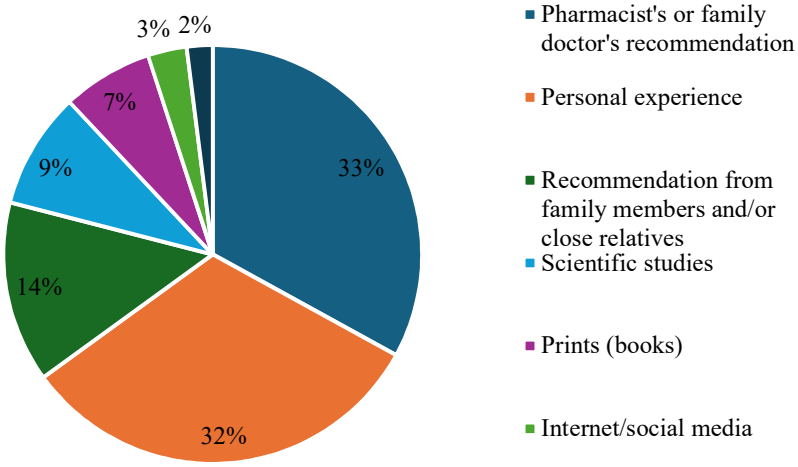

Fig. 2. Sources of information used when choosing treatments for children

It was revealed that in all age groups, the highest level of trust was placed in the recommendations of a pharmacist or family physician ($p = 0.05$). This trust increases with the child's age, while the significance of a family member's or close relative's experience simultaneously decreases ($p = 0.0005$). Parents of children aged 1–3 years trusted social media twice as much as parents of school-age children ($p = 0.05$) (Table 4).

The highest level of trust in personal experience was observed among grandmothers (36%), followed by mothers (30%) and fathers (22%). Compared with other family members, fathers were the most likely to trust recommendations from family members and/or close relatives (20%). Furthermore, fathers consulted scientific literature more frequently than both mothers and grandmothers [36].

Table 4

Information sources used when choosing treatments, categorized by the child's age

Source of information used (%)	Child's age in years		
	1–3	4–6	7–12
Recommendation of a pharmacist or family doctor	33	37	42
Personal experience	26	31	32
Recommendation from a family member or close relative	17	12	11
Scientific research	10	8	5
Printed publications (books, articles)	8	8	6
Social networks	4	2	1
Homeopathy	1	1	2
Other	0	2	1

Preferred methods of treating children.

In treating children, respondents showed a nearly equal preference for herb-based products (33%), pharmaceuticals (30%), and traditional (folk) medicine methods (27%). Those who preferred other alternative medicine methods or homoeopathy accounted for less than 10%. For younger children, preference was given to medication (27%) and herbal remedies (31%). The correlation between age and the preference for using herb-based products was $p = 0.03$. In the treatment of school-age children, the use of both medicinal plant materials (36%) and medications (32%) increased. Homoeopathy ($p = 0.03$) and the use of other alternative methods showed the opposite trend. The statistical reliability of the association between age and the treatment method was $p < 0.05$.

HMS safety assessment.

Respondents were asked to evaluate the importance of scientifically proven efficacy and safety of HMS to them. A total of 82% of respondents either "strongly agreed" or "somewhat agreed" with the statement, with 64% among them "strongly agreeing." In contrast, 6% of respondents either "strongly disagreed" or "somewhat disagreed" (Fig. 3).

When assessing the statement 'I believe that HMS are safer compared to synthetic drugs,' the majority of respondents (65%) fully or somewhat agree with this statement, whereas only 9% of respondents somewhat disagree or completely disagree with it (Fig. 4).

Analysis across different pediatric age groups revealed that parents of toddlers had the lowest proportion who "strongly agreed" with the statement (24%), while parents of preschoolers and school-age children had a 32% rate. The most sceptical attitude toward the safety of herbal remedies was observed among respondents who are pharmacists and pharmacy technicians; only 10% of them

"strongly agreed" with the statement, while 13% "strongly disagreed" entirely. This may be explained by their deeper professional knowledge of the subject. Numerous international studies have reached similar conclusions, indicating that a significant number of respondents do not believe that herbal preparations have side effects or can interact with other medicinal products [12, 29, 30].

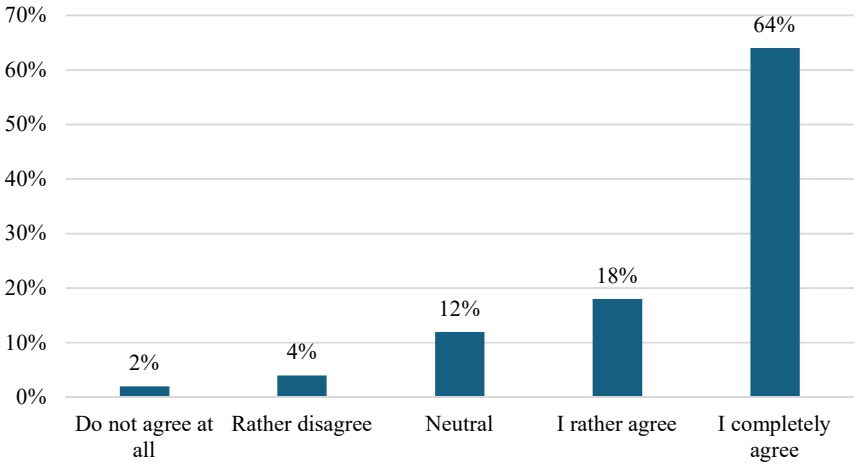

Fig. 3. Results of agreement with the statement 'It is important to me that the HMS used by children have scientifically proven effectiveness and safety'

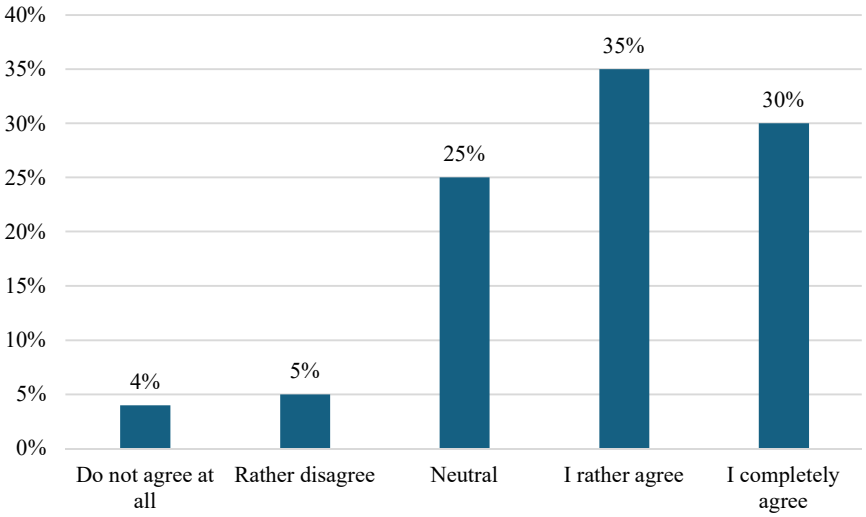

Fig. 4. Agreement with the statement: 'I believe that HMS are safer compared to synthetic drugs'

Treatment of children using HMS.

Among toddlers, the use of HMS was lower (79%) than among preschoolers (83%) and school-age children (82%), which is consistent with previous research [37]. When analyzing HMS use by the child's gender, it appears that girls (83%) utilized them more frequently than boys (79%); this correlates with data from earlier studies [37]. Across all age groups, the most common frequency of HMS use was once every three months, while the least frequent was once a year. Nearly three-quarters of the respondents used herbal remedies at least once every six months (Fig. 5).

Grandmothers were the most frequent users of herbal remedies, utilizing them more often than once every six months (78%), followed by fathers (72%) and mothers (33%).

Among the respondents, three-quarters used HMS upon the onset of cold-related symptoms. Most commonly, herbal products were used to treat coughs (26%) and rhinitis/runny nose (21%), while they were less frequently used for digestive disorders (12%), skin problems (6%), eye diseases (5%), and allergies (2%). In the two younger age groups, cold-related symptoms accounted for 74% of the reasons for use, whereas among school-age children, usage for cold-related conditions was lower (71%).

In the analysis of dosage forms used for HMS, it was established that the most frequently mentioned method of administration was infusions made from raw materials (22%). Inhalations and topical forms (ointments, creams, or liniments) were used with equal frequency (15%), followed by syrups (14%) and other liquid dosage forms, as well as external applications such as compresses, decoctions, and wraps (13%) or other methods. Additionally, essential oils, baths, and homoeopathy were utilized. Respondents believed that the dosage form depended on the illness and the specific situation: 43% preferred liquid dosage forms for children, only 10% preferred solid oral forms, and 28% favoured external application of herbal remedies. Furthermore, 27% of grandmothers, 24% of fathers, and 21% of mothers preferred herbal teas.

Analyzing usage by age group, it was found that the use of HMS increases as the child grows ($p = 0.003$): 19% among toddlers (1–3 years), 22% among preschoolers (4–6 years), and 25% among school-age children (7–12 years). The number of respondents who prefer tablets or capsules also increases with age ($p = 0.0003$): from 3% in toddlers to 6% in school-age children. A similar trend is observed in the use of medicated lozenges (lozenges/candies), as well as in the use of fresh MPRM. Conversely, the use of ointments, creams, or liniments decreases with age ($p = 0.0005$).

Chamomile (*Matricaria chamomilla*) was the most popular medicinal plant –more than three-quarters of the children who used HMS were given preparations made from chamomile flowers. Slightly less frequent was the use of linden flowers, garlic bulbs, and mint leaves. Fewer than half of the children used calendula flowers, blueberry fruits, or aloe leaves. Statistically significant correlations between age and the use of specific HMS were identified for calendula flowers ($p = 0.001$), blueberry fruits ($p = 0.03$), and chamomile flowers ($p = 0.0002$$).

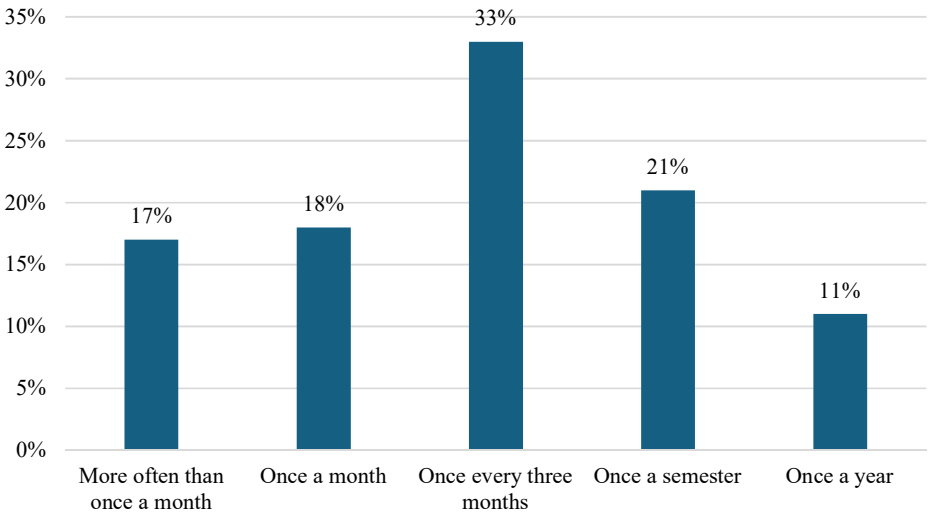

Fig. 5. Frequency of HMS use by children under 12 years old

On average, 3.95 different HMS were used per child over the course of a year. Two or more types were used by 98% of children, and four or more types by 59%. All seven types of HMS listed in the questionnaire were used by 30 children (9.3%).

As age increased, the number of different HMS used also rose: while 1-year-old children were given 3.3 types on average, 12-year-olds were given 4.5. The relationship between age and the number of HMS used was statistically significant ($p < 0.006$). On average, 3.2 types were used for girls and 3.0 for boys.

Over the past year, mothers used the specified plant materials an average of 3.9 times, fathers 4.1 times, and grandmothers 4.8 times. It was a surprising finding that fathers utilized more HMS than mothers.

Slightly more than three-quarters of the respondents rated the effect of herbal remedies as "very good" or "fairly good" (Table 5), which is higher than the rating observed in Germany among children using herbal medicinal products [13].

Table 5

Respondents' evaluation of the efficacy of MPM and herb-based preparations

HMS	Evaluation of effectiveness HMS (%)				
	It didn't help at all	It probably didn't help	Neutral	Fairly good	Very good
Aloe leaves	0	0	7	32	61
Calendula flowers	0	2	15	44	39
Blueberry fruits	0	1	19	35	44
Garlic bulbs	0	2	19	40	38
Linden flowers	0	2	27	44	26
Chamomile flowers	0	2	25	39	33
Mint leaves	1	3	29	34	32

Characteristics of the use of 7 studied types of MPRM.

Chamomile flowers and their preparations were used by 80% ($n = 466$) of children who consumed HMS. The average age of chamomile users was 6.3 years. The most frequent reason for use was cold symptoms, accounting for 47% of cases, followed by digestive disorders (27%) and eye diseases (18%). For skin problems, chamomile was used in 6% of children, and for allergies in 1.4%. More than half (55%) of users consumed chamomile as tea. External use, such as compresses, poultices, wraps, or other methods, was lower (30%). Steam inhalations were also popular (6.5%). The application for cold symptoms, digestive disorders, and external use for skin issues aligns with EMA recommendations [34]. Since the EMA suggests chamomile tea for digestive disorders from six months of age, it can be assumed that its use in children under 12 is safe [34].

Linden flowers were used by 59% ($n = 340$) of children, with an average age of 6.4 years. Increased use of linden flowers in older children was also observed in studies conducted in Romania and Moldova [38]. Nearly 96% of children consumed linden preparations at the onset of cold symptoms, while 2% used them for digestive disorders. The most popular method of administration was tea (89%). Use for colds aligns with EMA guidelines [34]; however, although the EMA recommends linden tea for children over 4 years old, this study showed that 25% of users were under 4 years old, which deviates from official recommendations.

Peppermint leaf was utilized by 55% ($n = 319$) of children (average age 6.7 years). Cold symptoms were the primary reason for use (81%), followed by digestive disorders (10%). Additionally, 4% of respondents used peppermint for sleep disturbances or as a sedative. Tea was the most popular form (66%), followed by steam inhalations (10%) and medicated lozenges (8%). Other forms (essential oil, aroma patches, nasal drops) were used in fewer than 5% of cases. The EMA recommends peppermint tea from age four. However, 34% of users in this study were under four, and 3% were under two. The use of peppermint oil is contraindicated in children under 2, and safety has not been established in those under 4 [34]. In this study, side effects were noted in two-year-old children. While the EMA recommends peppermint for digestive disorders and oil inhalations for cold symptoms only in children over 12, its use in tea (which contains small amounts of essential oil) may be partially justified but requires caution in younger pediatric groups [34].

Fewer than half of the children (49%; $n = 283$) used calendula flowers (average age 6.5 years). Primary reasons included cold symptoms (51%) and skin problems (33%), followed by digestive disorders (6%), allergies (3%), and eye diseases (3%). Treatment of wounds/scratches and insect bites was also mentioned. Most commonly, calendula was used as an ointment/cream (29%), tea (26%), or tincture/liquid extract diluted

with water (20%). Throat sprays were used by 14 children (six specified a sea buckthorn-calendula combination). The EMA recommends calendula for minor skin lesions and inflammation of the mouth and throat [34]. Despite 40% of users being under six, safety for skin use is not established for children under four, and for oral mucosa, it is only recommended for those over 12.

Blueberry fruits were used by 48% ($n = 277$) of HMS users (average age 6.5 years). Over half of the reasons for use were digestive disorders (59%), followed by cough (10%), rhinitis (7%), and fever (7%). Blueberries were also used for their pleasant taste, recovery after illness, as a vitamin source, and for immune support. Consumption was mainly fresh or frozen (56%), with tea (17%) and food inclusion (8%) being less common. The EMA specifies the use of dried blueberries for diarrhoea [39]. While this study confirms digestive disorders as the primary reason, no respondents specifically mentioned using the dried form. Use in fresh form is based on long-standing tradition and is likely safe [40].

Garlic bulbs were used by 43% ($n = 334$) of children (average age 6.1 years). The main reason was cold symptoms (81%), predominantly rhinitis (43%), followed by cough (29%), sore throat (9%), and immune support (3%). Other mentions included use against ticks, toothache, and parasites. Garlic was consumed fresh (42%), as compresses/poultices (21%), inhalations (11%), in food (9%), or hung near the bed (7%). It was often used preventively, despite limited scientific evidence [41]. Use for colds aligns with EMA guidelines; however, the agency does not recommend dry extract for children under 12 [42]. Dietary consumption is generally safe, but caution is advised with fresh garlic due to the risk of gastrointestinal irritation [43].

Aloe leaves or preparations based on them were used by 41% ($n = 239$) of children. The average age of aloe users was 6.2 years. Most respondents used aloe-based remedies for skin problems (54%). The second most common use was for rhinitis (14%), followed by burns/sunburns (13%); only 1% of respondents used aloe for digestive disorders. Among other reasons, respondents cited rhinitis (instilling aloe juice into the nose, 14%), cough (6%), and sore throat (2%). Aloe was also applied for insect bites, warts, blisters, oedema, injuries, bruises, and as a general tonic. The most popular administration method was in the form of an ointment, cream, or liniment (42%). Significantly less common was its use as a compress, poultice, wrap, or other external methods (27%). Fresh aloe leaves were used by 23% of respondents. Aloe was often administered with honey, and for rhinitis, nasal sprays containing seawater and aloe juice were also used. The EMA recognizes the evidence-based use of aloe leaves for treating constipation in children over 12 years of age [44].

In this study, internal use for digestive disorders accounted for only 1% of responses. Notably, the EMA does not provide specific guidelines for the external use of aloe. While some studies indicate a positive effect of aloe on wound healing, a clinical consensus regarding this effect has not yet been reached [45].

Among the participants, 66% of children used other treatment methods alongside MPRM or herb-based preparations. The plants most frequently used in combination with other treatments were chamomile (78%), aloe (77%), and linden (72%), followed by garlic (68%), peppermint (66%), blueberry (51%), and calendula (51%).

Characteristics of the use of other types of HMS.

In response to the question asking to name other types of HMS used for treating children, 237 (35%) respondents provided data. In addition to the MPRM specified in the survey, 99 other types of MPM and 17 preparations were identified. The three most frequently mentioned other medicinal plants were onion (7%), Iceland moss (6%), and cowslip primrose (4%) (Table 6).

The most frequently mentioned preparations included mustard powder (6), Sinupret (5), Husatgil (4), Carmolis (3), and activated charcoal (2). Furthermore, respondents mentioned using minerals (zinc and magnesium), goose fat ointment, saline solution, and salt compresses.

Table 6

Other most widely used HMS for the treatment of children

Medicinal plant	Users HMS	
	n	%
Onion	34	7
Iceland moss	33	6
Cowslip	21	4
Meadowsweet	17	3
Raspberry	17	3
Sea buckthorn	16	3
Ginger	16	3
Honey	15	3
Coltsfoot	15	3
Plantain	15	3
Blackcurrant	14	3
Yarrow	14	3
Rosehip	12	2
Eucalyptus	11	2
Spruce	11	2
Ivy	11	2
Sage	10	2
Pau d'Arco	10	2
Tea tree	10	2

Among those mentioned were also medicinal plants whose use is not recommended for children under 12 years of age, such as coltsfoot, meadowsweet, St. John's wort, sage, yarrow, raspberry (leaves), nettle, bearberry, and Ginkgo biloba [34].

Side effects of HMS use in children.

Side effects were observed in 15 children who took HMS (2.6%). Garlic (in 5 children) and peppermint (in 4 children) were the most frequent causes of side effects. Fewer side effects were observed with the use of blueberry (in 3 children), chamomile (in 2 children), and linden (in 1 child). No side effects were reported in children who used calendula or aloe.

HMS use during pregnancy.

During pregnancy, the most frequently used remedies were derived from chamomile, peppermint, linden, and calendula (Table 2). Among pharmaceutical preparations, the most commonly used were: Gelomyrtol (a special distillate of rectified eucalyptus, sweet orange, myrtle, and lemon oil); Sinupret — which is generally not recommended for those under 18 (containing *Gentianae luteae radix*, *Primulae flos*, *Rumicis herba*, *Sambuci nigrae flos*, and *Verbenae officinalis herba*); Carmolis (containing menthol and essential oils of thyme, anise, Chinese magnolia-vine, lemon, lavender, spike lavender, citronella, sage, and nutmeg); Floradix (a complex of vitamins, minerals, and plant extracts); Hustagil balm for external use (containing *Eucalypti globuli* leaf oil, *Lavandulae angustifoliae* oil, and *Thymi vulgaris* oil); Ilsa/Min lozenges (Icelandic moss-based).

Additionally, pregnant women consumed supplements containing Vitamin C, magnesium, folic acid, and calcium.

The reasons for use included cold-related symptoms and digestive disorders, as well as for the pleasant taste and to prevent nausea and vomiting. Before childbirth, decoctions of raspberry leaves and thyme herb were used to activate uterine contractions and stimulate muscle activity; however, such use is only recommended after the 36th week of pregnancy. Notably, respondents mentioned several MPRM species that are generally not recommended during pregnancy, including: creeping/common thyme (19), linden blossom (71), calendula/oil (55), fennel (42), caraway tea (12), raspberry leaves/stems (19), Iceland moss (7), primrose (9), yarrow (3), sage (4), oregano (1), valerian (2), motherwort (1), and coltsfoot (3) [46, 47].

HMS use during breastfeeding.

The most frequently mentioned preparations used during breastfeeding to promote lactation included: Maria Lactation capsules (containing royal jelly, fenugreek seed powder, fennel fruit powder, cumin fruit powder, dandelion root powder, and hawthorn leaf and flower powder); Gelomyrtol; Isla/Moos/Mint; Propolki (with propolis and vitamin C); Sinupret and various herbal teas.

HMS were also utilized to treat cold-related symptoms, manage mastitis, and reduce gas-related colic in infants; in some cases, they were consumed simply as beverages. Several HMS were used during breastfeeding despite a lack of established safety data. These included: raspberry (11), aloe (14), nettle (9), wild pansy tea (1), speedwell (Veronica) (2), blackberry (1), stonecrop (Sedum) (2), lemon balm (8), lingonberry (3), yarrow (5), linden (70), calendula (44), and sage (3) [48].

Practical relevance. Since herbal raw materials and herbal medicinal products play a significant role in the treatment of children and are also used during pregnancy and lactation, and as the study results indicate the use of products not recommended by the EMA, there is an urgent need to inform the public about the proper use of medicinal plants and the potential risks associated with their use.

Research limitations. The study limitations include regulatory documents that restrict the use of herbal remedies due to insufficient evidence, their contraindications, and specific prescribing requirements for phytopharmaceuticals in pediatric practice, as well as for pregnant and breastfeeding women.

Prospects for further research. Future research requires randomized controlled trials (RCTs), which serve as the foundation of evidence-based medicine. Furthermore, it is essential to implement specialized courses for pediatric students. These courses should cover the fundamental principles of phytotherapy, including concepts of biologically active compounds in medicinal plants, herbal mixtures, phytopharmaceuticals, as well as their pharmacological properties, toxicity, and side effects.

6. Conclusions

Since herbal raw materials and herbal medicines play an important role in the treatment of children, and are also used during pregnancy and breastfeeding, and given that research results indicate the use of products not recommended by the EMA, there is an urgent need to inform doctors and the public about the use of medicines not recommended by the EMA, the correct use of herbal medicines and the potential risks associated with their use.

Conflicts of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this article.

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Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

The authors confirm they did not use artificial intelligence technologies when creating the current work.

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Authors’ contributions

Ain Raal: conceptualization, methodology, validation, investigation, resources, data curation, writing – original draft, writing – review & editing, supervision, and project administration; **Elen Nikker:** formal analysis, investigation, data curation, writing – original draft, and visualization; **Tetiana Ilina:** methodology, validation, formal analysis, investigation, data curation, writing – original draft, writing – review & editing, and visualization; **Alla Kovalyova:** validation, formal analysis, investigation, data curation, writing – original draft, writing – review & editing; **Oleh Koshovyi:** conceptualization, methodology, validation, investigation, writing – original draft, writing – review & editing, and supervision.

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