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Study of Public Knowledge on the Use of Herbal Medicines and Their Interactions

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ABSTRACT

The use of herbal medicines has increased significantly in the past two decades, particularly in developing countries like Indonesia. This phenomenon is largely influenced by the perception that herbal medicines are safer due to their natural nature, although public understanding of scientific aspects, such as dosage, drug interactions, and side effects, remains very limited. Various studies have shown that combinations of herbal and conventional medicines, such as ginkgo biloba with anticoagulants or St. John's wort with antidepressants, can cause dangerous pharmacological interactions, including toxicity and decreased therapeutic efficacy. The lack of formal health education and the dominance of information from social media and advertising exacerbate misinformation in the community. Furthermore, many health workers have not received training in herbal pharmacology, thus preventing them from providing optimal evidence-based education. Weak regulations on the distribution and labeling of herbal products also contribute to the risk of unsafe self-medication practices. This study used a literature review with a qualitative-descriptive approach to assess the level of public knowledge and the risks of herbal drug interactions. The results are expected to form the basis for the development of integrative educational and regulatory policies to improve public health literacy and ensure safer, more rational, and evidence-based use of herbal medicines.

INTRODUCTION

The use of herbal medicines has increased significantly in the past two decades, particularly in developing countries, including Indonesia. This phenomenon is closely linked to the public perception that herbal medicines are more natural and safer than chemical drugs. Research by Ekor et al. (2021) suggests that public belief in the efficacy of traditional medicines is strongly influenced by culture, local values, and inherited experiences. However, this trend is often not accompanied by adequate scientific understanding of dosage, indications, contraindications, and the risk of drug interactions.

Limited public knowledge regarding pharmacological interactions between herbal medicines and conventional drugs is a significant issue in public health practice. Several studies, such as those reported by Zavitra et al. (2025), indicate that the simultaneous use of herbs such as ginkgo biloba, ginseng, or anticoagulant or antidepressant medications can cause harmful pharmacodynamic and pharmacokinetic effects. These interactions can lead to toxicity, decreased therapeutic efficacy, or even serious side effects such as bleeding or organ failure.

Furthermore, a major contributing factor to this low awareness is the lack of formal health education and counseling regarding herbal medicines and their interactions. People generally obtain information from unreliable sources such as social media, commercial advertisements, or stories from relatives, as highlighted in a study by Dores et al. (2023). This lack of valid and scientifically verified information resources increases the likelihood of misinformation, which in turn can encourage unsafe self-medication.

In this context, the role of healthcare workers is crucial in providing accurate information to the public. However, a systematic review by Zaidi et al. (2022) showed that many healthcare workers have not received adequate training in herbal pharmacology and their interactions. This creates a gap in healthcare services that should serve as the frontline in bridging public knowledge with evidence-based medical practices.

The lack of strict regulations on the distribution and information of herbal medicines also exacerbates the situation. In Indonesia, many herbal products are sold freely without clinical trials and proper distribution permits. Some products even contain synthetic chemical compounds that consumers are not informed about, as found in a 2022 study by the Indonesian Food and Drug Authority (BPOM). This highlights the urgent need for intervention by health authorities and strengthening of public safety-based regulatory systems (Abudalo et al., 2022).

Empirical studies on the level of public knowledge are urgently needed to identify gaps in understanding and demographic characteristics that influence their perceptions of herbal medicine. Qualitative and quantitative approaches in such studies will provide a comprehensive picture of community mindsets, which is crucial for designing contextual and effective educational intervention programs (Jermini et al., 2019).

Furthermore, it is important to emphasize that public knowledge is not only about awareness of interaction risks, but also about understanding the basic principles of phytotherapy, such as effective dosage, extraction methods, and stability of active ingredients. This lack of understanding leads many users to misinterpret the effectiveness of herbal products based solely on taste or short-term experience, without understanding the biological mechanisms of action of the compounds consumed (Mohammadi et al., 2020; Al Harbi et al., 2022).

Therefore, strengthening public health literacy regarding the use of herbal medicines and their potential interactions with other drugs must be a strategic priority in modern healthcare systems. Through collaboration between academics, health practitioners, government, and the media, an evidence-based health education curriculum can be developed to provide the public with comprehensive knowledge. Only with this integrative approach can the risks of unsafe use of herbal medicines be minimized and overall public health improved.

METHODOLOGY

This study used a descriptive qualitative approach with a literature review method to analyze public knowledge regarding the use of herbal medicines and their interactions with conventional drugs. Data were collected from scientific journals, books, and official agency reports published in the last five years (2019–2024), through searches through databases such as PubMed, Scopus, ScienceDirect, Google Scholar, and Garuda Ristekbrin. Literature selection was carried out systematically using inclusion and exclusion criteria, then analyzed using a thematic approach to identify key themes such as level of knowledge, information sources, and perceived risk of drug interactions. Data validity was maintained through source triangulation and peer discussion to avoid interpretation bias. This study aims to provide a comprehensive overview of the public literacy gap and serve as a basis for developing educational policies that support the safe and rational use of herbal medicines.

RESULTS AND DISCUSSION

Level of Public Knowledge regarding the Use of Herbal Medicines

Herbal medicines, as part of complementary and alternative therapies, have seen significant increases in popularity in various countries, including Indonesia, as public awareness of natural and preventative lifestyles grows. However, this euphoria is not always accompanied by a comprehensive understanding of the pharmacodynamic and pharmacokinetic principles of herbal compounds, creating a gap between public belief and available scientific evidence.

In general, public perception of herbal medicines is heavily influenced by the belief that natural products are synonymous with high safety. This assumption is a form of naturalistic fallacy, the assumption that anything derived from nature is safe and superior to synthetic products (Aulia et al., 2022). Scientific literature actually shows that a number of medicinal plants contain active compounds that are highly toxic or have the potential for antagonistic interactions with conventional drugs. For example, the use of Hypericum perforatum (St. John's Wort) has been shown to reduce the effectiveness of antidepressants and oral contraceptives through the induction of cytochrome P450 enzymes. However, this knowledge remains largely unknown to the general public.

Formal education and access to credible medical information are important determinants in developing a rational and evidence-based understanding of herbal medicines. Individuals with higher education tend to have better health literacy skills, including accessing, evaluating, and applying information regarding the benefits and risks of herbal medicines. Conversely, people with lower education levels are more vulnerable to misinformation, particularly through social media, commercial advertisements, and anecdotal narratives without a valid empirical basis.

Furthermore, cultural influences and traditional belief systems are highly influential in shaping the practice of consuming herbal medicine. In many agrarian and ethnobotanical communities, the use of medicinal plants is an integral part of local wisdom passed down through generations. This traditional knowledge, despite its historical and ecological value, often lacks scientific validation. Consequently, there is the potential for perpetuation of inaccurate or even harmful information. Within the framework of medical anthropology, this phenomenon is referred to as the emic perspective, which refers to a community's internal perspective on health practices based on their own cultural context (Alyami et al., 2020).

Furthermore, the intended use of herbal medicines also reflects differing levels of understanding. Some people use herbal medicines as primary therapy for chronic or acute illnesses without medical supervision, which can potentially worsen clinical conditions if not administered appropriately. Meanwhile, individuals with higher levels of knowledge generally use herbal medicines as adjuvant therapy within preventive and promotive frameworks, such as to boost immunity or manage stress.

Public confidence in the effectiveness of herbal medicines does not always align with clinical and pharmacological data. Many therapeutic claims are not supported by valid and reliable clinical trials. For example, claims that soursop leaf extract can treat diabetes are still in the preclinical trial stage, yet it is widely believed by the public as a substitute for insulin therapy (Al Akeel et al., 2018). This demonstrates a knowledge gap between modern science and public perception, necessitating evidence-based educational interventions.

The lack of strict regulations regarding the labeling and distribution of herbal products in the open market further exacerbates the situation. The lack of information on product labels regarding ingredients, dosage, and potential side effects leaves consumers with insufficient knowledge to make informed decisions. This leaves unscrupulous manufacturers open to marketing products with misleading claims, without the support of clinical trials or adequate pharmaceutical oversight.

In the context of public health policy, increasing literacy in herbal medicines should be a priority. This strategy can be realized through the integration of health education into formal curricula, training of health cadres, and community-based educational campaigns that combine scientific approaches with local wisdom. A transdisciplinary approach involving medical personnel, pharmacologists, anthropologists, and science communicators is essential to produce contextual and sustainable interventions.

Thus, it can be concluded that the level of public knowledge about herbal medicines is an important indicator in ensuring the safety, effectiveness, and rationality of their use. The complexity of influencing factors, ranging from education and culture to regulations, demands a holistic, evidence-based approach in designing appropriate intervention strategies to improve the quality of herbal medicine consumption in the community.

Risks of Interactions between Herbal Medicines and Conventional Medicines and Their Implications for Health

In the last decade, the increasing use of herbal medicines as complementary or alternative therapies to conventional therapies has raised new concerns in clinical practice, particularly regarding the potential for unanticipated pharmacological interactions. Interactions between herbal medicines and conventional medicines are a critical issue that can alter the pharmacokinetic and pharmacodynamic profiles of a compound, impacting therapeutic efficacy or increasing the risk of toxicity. This phenomenon poses a significant challenge in therapy management, particularly in patients with comorbidities undergoing polypharmacy (Pane et al., 2021).

Pharmacokinetically, active compounds in phytotherapeutic products have the ability to induce or inhibit metabolic enzymes, particularly enzymes from the cytochrome P450 (CYP450) family, which play a central role in the biotransformation of most synthetic drugs. For example, Hypericum perforatum (St. John's Wort) is known to induce the expression of the CYP3A4 enzyme, which can significantly

decrease the plasma concentrations of various drugs such as cyclosporine, midazolam, indinavir, and oral contraceptives, thus compromising their therapeutic effects. On the other hand, components in grapefruit juice, such as furanocoumarins, act as CYP3A4 enzyme inhibitors, causing increased levels of drugs such as statins and calcium channel blockers in the systemic circulation, which can lead to serious side effects such as myopathy or hypotension.

From a pharmacodynamic perspective, interactions can occur when the physiological effects of herbal medicines enhance (synergistic) or counteract (antagonistic) the effects of conventional medications. For example, concomitant consumption of Ginkgo biloba, which has antiplatelet effects, with warfarin or aspirin can increase the risk of intracranial or gastrointestinal bleeding due to additive effects on the coagulation pathway. Meanwhile, Panax ginseng is known to interact with antihypertensive agents, such as lisinopril or atenolol, by reducing their effectiveness and causing refractory hypertension. These cases demonstrate that pharmacodynamic interactions can occur even though they do not occur through the same metabolic pathway, but rather through physiological actions on similar molecular targets or organ systems (Al Mukminah & Indradi, 2021).

Clinical evidence regarding the impact of these interactions is increasingly being reported through observational studies, case reports, and limited clinical trials. For example, reports of hepatotoxicity following the simultaneous consumption of kava-kava (Piper methysticum) and paracetamol, or nephrotoxicity following the consumption of Aristolochia spp., emphasize that the risk of herbal use lies not only in its intrinsic toxicity but also in its potential to exacerbate the side effects of other concomitant medications. In these circumstances, early detection of clinical manifestations resulting from interactions is crucial, but is often hampered by a lack of patient knowledge and limitations in adverse event reporting systems in healthcare facilities.

The clinical consequences of these interactions are more significant in populations with physiological vulnerabilities, such as the elderly, patients with kidney failure, liver disease, and pregnant and lactating women. In these groups, impaired drug metabolism and excretion can increase the accumulation of active compounds from both herbal and conventional medicines, thereby increasing the potential for systemic toxicity. In this context, adverse drug reactions (ADRs) caused by cross-pharmacological interactions are a significant patient safety issue (Raharjo, 2022; Diwyami & Dewi, 2022).

The public's lack of pharmacological literacy regarding herbal products is one factor exacerbating this situation. Many consumers perceive herbal medicines as "natural" and therefore safe, unaware that the phytochemical compounds they contain possess high bioactivity that can have significant clinical effects, especially when combined with conventional pharmacological therapies. Evidence-based public education and increased competency of healthcare professionals are key to mitigating this risk.

Healthcare professionals must be proactive in identifying potential herbal medicine use during the medical history, including inquiring about the brand, dosage, and frequency of use. Furthermore, the national pharmacovigilance system needs to be strengthened with reporting mechanisms that include herbal products, which have traditionally been overlooked in reporting adverse events. The involvement of clinical pharmacists in interaction risk assessments is also essential to ensure the safety of

patients' therapeutic regimens.

On the regulatory side, harmonization of traditional medicine and modern pharmaceutical regulations is needed. Herbal products circulating in the community generally do not undergo systematic interaction testing before being marketed, and minimal information on contraindications and potential interactions is included on packaging labels. Therefore, the role of the Food and Drug Monitoring Agency (BPOM) and other certification bodies is crucial in developing interaction testing standards and post-market monitoring for traditional medicines and herbal supplements (Bertorio, 2025).

Thus, discussions regarding the interaction of herbal and conventional medicines require a multidisciplinary approach involving pharmacology, toxicology, clinical epidemiology, and public health regulations. Only through the integration of science and evidence-based policy can therapeutic safety be assured, and the potential synergy between traditional and modern medicine be optimized rationally and responsibly.

Challenges of Education, Access to Information, and Regulation in the Use of Herbal Medicines

Low health literacy regarding herbal medicines can be seen as a manifestation of a systemic failure to distribute scientific knowledge equitably and accountably to the public. Information regarding the efficacy, dosage, side effects, and interactions of herbal medicines is often incompletely conveyed, leading the public to rely on traditional knowledge or popular narratives from social media that are speculative and non-evidence-based.

One crucial dimension that exacerbates this challenge is the weak institutional capacity to establish a regulatory and oversight system for herbal preparations circulating in the market. Many phytotherapy products are sold freely without undergoing a rigorous scientific evaluation process for quality, safety, and efficacy, such as preclinical trials or clinical trials based on Good Clinical Practice (GCP). The lack of standardization of active plant ingredients, extraction methods, and manufacturing processes directly impacts inconsistent product quality, and in many cases, can lead to toxic reactions, adverse pharmacological interactions, or even contain dangerous contaminants such as heavy metals and pathogenic microorganisms (Sari 2024; Mirzaeian et al., 2021).

On the other hand, epistemological gaps are also found in the healthcare profession. The lack of integration of phytotherapy into medical and nursing curricula results in healthcare workers lacking the competency to provide scientific education or counseling to patients regarding herbal medicines. This reinforces the phenomenon of pseudo-authority in society, where individuals prefer to obtain information from non-medical figures with popularity on social media, even though the validity of their knowledge is uncertain. The dominance of narratives from digital influencers and herbal producers that emphasize benefits without including scientific warnings contributes to the proliferation of misconceptions and exaggerated expectations about the effectiveness of herbal remedies (Saggar et al., 2022).

These challenges are further complicated by the limited access to credible sources of information in communities, whether due to geographic, economic, or digital barriers. Consequently, the use of herbal remedies often involves a lack of professional consultation, relying solely on the experiences of those closest to them or persuasive advertising. The public's inability to critically evaluate the information they receive, a

phenomenon known as low health literacy, is at the root of the irrational use of herbal remedies.

To address this issue, a unidirectional educational approach is no longer relevant. A collaborative and transdisciplinary educational model is needed, involving stakeholders from across sectors such as the government (through the Ministry of Health and the Food and Drug Authority), academic institutions, professional organizations, and digital platforms. This collaboration is crucial in shaping a health information architecture that is not only scientifically accurate but also communicative, adaptable to digital dynamics, and inclusive of the wider community (Kosoe et al., 2024). A scientifically data-driven risk communication strategy must also be developed to counter misinformation that often spreads widely through social media.

Regulatory aspects also require normative and operational revitalization. The government must strengthen regulations by implementing an evidence-based registration system for all herbal products in circulation, as well as tightening post-market surveillance mechanisms through the involvement of independent testing laboratories and active community participation in the adverse event reporting system (pharmacovigilance). Policy expansion should also include incentives for phytopharmaceutical research based on local biodiversity as a means of enhancing biodiversity-based health sovereignty.

In the digital era, developing an open-access, integrated digital educational ecosystem with healthcare platforms is a strategic choice. The use of educational applications, interactive databases, and communication media based on scientific visualization can improve public understanding of the safety and rationality of herbal medicine use (Silveira et al., 2018). However, this transformation can only be achieved if supported by a responsive, progressive national policy framework that is oriented toward continuously strengthening public health literacy capacity.

Overall, the challenges of education, access to information, and regulation in the use of herbal medicines reflect a multidimensional challenge involving social, technological, legal, and cultural factors. Without comprehensive and collaborative structural interventions, the use of herbal medicines risks becoming a practice that is not only therapeutically ineffective but also detrimental to public health in the long term.

CONCLUSION

Herbal medicines have seen a significant increase in public use in response to healthy living and preventative medicine trends. However, this euphoria for natural products has not been matched by an adequate understanding of their pharmacological and scientific aspects. The perception that all herbal products are safe because they are "natural" is a misleading naturalistic fallacy and is inconsistent with verified toxicology and drug interaction data. Scientific evidence shows that many active compounds in medicinal plants can interact pharmacokinetically and pharmacodynamically with conventional drugs, leading to altered therapeutic efficacy and increased risk of toxicity. Unfortunately, weak regulation and a lack of transparency regarding information on herbal products on the market exacerbate the situation, as consumers are not provided with accurate information. Furthermore, low levels of health literacy in some communities make misinformation from social media and influencers more credible than evidence-based knowledge. Health worker education curricula also lack the integration of phytotherapy, leaving many health professionals lacking the educational capacity to use herbs scientifically. As a result,

the public is more likely to rely on pseudo-authoritative sources that are often inaccurate and commercial in nature. Limited geographic and digital access also exacerbate the information gap, ultimately reinforcing the practice of using herbal medicines without medical supervision. Meanwhile, the regulatory system and post-market oversight of herbal products remains fragmented and poorly adapted to rapid market dynamics. Addressing these challenges requires a collaborative approach involving the health sector, academia, regulators, and digital platforms to design inclusive educational and regulatory strategies. Without evidence-based and collaborative structural interventions, the use of herbal medicines risks becoming a practice that is not only ineffective but also harmful to public health in the long term.

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