Inventum Biologicum: *An International Journal of Biological Research*
2024, Vol. 4, Issue 3, pp. 43-51

Inventum Biologicum

Journal homepage: www.journals.worldbiologica.com/ib

Research paper

Cardio-Metabolic Ailments Treated by the Non-Institutionally Trained Siddha Practitioners of Virudhunagar District of Tamil Nadu, India

Murugan Shanmugam Meena [a], **Samraj Wilson** [b], **Ganapathy Vanaraj** [c], **Edwin Edward-Sam** [d], **Rathinavel Kanthasamy** [e], **Thomas Michael Antony Packiam** [f], **Subramanian Mutheeswaran** [c] *

[a] *National Institute of Siddha, Tambaram Sanatorium, Chennai, Tamil Nadu, India*
[b] *Department of Botany, St. John's College, Palayamkottai, Tirunelveli, Tamil Nadu, India*
[c] *Xavier Research Foundation, St. Xavier's College, Palayamkottai, Tirunelveli, Tamil Nadu, India*
[d] *Department of Microbiology, Division of Virology and Molecular Biology, St. Peters Medical College Hospital & Research Institute, Hosur, Tamil Nadu, India*
[e] *Biologist, District Forest Office & Wildlife Warden, Tirunelveli, Tamil Nadu, India*
[f] *Research Scholar, Department of Zoology, S T Hindu College, Nagercoil – 629002, India*

ARTICLE INFO

Article history

Received 11 September 2024
Revised 18 September 2024
Accepted 18 September 2024
Published 21 September 2024

Keywords

- Ethnomedicinal knowledge
- Siddha medicine
- Cardio-metabolic disorders
- Medicinal plants
- Traditional healers
- Virudhunagar district

ABSTRACT

The Siddha system of medicine, originating in Tamil Nadu, India, is a traditional practice recognized for its effectiveness in managing cardio-metabolic disorders, including diabetes, hypertension, and cardiovascular diseases. This study explores the ethnomedicinal knowledge of 65 non-institutionally trained Siddha practitioners in Virudhunagar district, who were interviewed from July 2021 to April 2023 using semi-structured questionnaires. The practitioners identified 83 plant species from 45 botanical families, with the most cited being *Gymnema sylvestre* (68%), *Aegle marmelos* (54%), *Andrographis paniculata* (49%), *Terminalia arjuna* (46%), and *Phyllanthus emblica* (43%). The primary preparations included decoctions (62%), powders (24%), and pastes (14%), administered orally with dosage adjustments based on patient conditions. The socio-demographic analysis revealed that 78% of practitioners were male, with an average age of 55 years, and 65% had inherited their knowledge through family traditions. Furthermore, 71% lacked formal Siddha education, relying solely on ancestral knowledge. A consensus index of 0.75 indicated strong agreement among practitioners on plant use for specific conditions. The study highlights the importance of preserving this undocumented ethnomedicinal knowledge and suggests that integrating these practices into modern healthcare could help address the rising burden of cardio-metabolic disorders in rural India. Further pharmacological studies are recommended to validate the therapeutic potential of these plants.

DOI 10.5281/ib201124

***Corresponding author:** Subramanian Mutheeswaran
Email: muthees2009@gmail.com

1. Introduction

Ethnomedicine encompasses the cultural interpreta--tions of health, disease, and illness, integrating the use of natural resources in healing practices. Despite advancements in modern medicine many communities

continue to rely on plants as alternative remedies, often used alongside biomedical treatments. The use of traditional medicine varies significantly based on geographical regions and the availability of natural resources. India, known for its vast biological diversity, is home to approximately 7% of the world's flowering plant species. The Western Ghats, a region rich in biodiversity, also hosts various ethnic groups who maintain traditional healing practices. Although some ethnobotanical studies have been conducted in the Western Ghats of Tamil Nadu, many areas still require comprehensive research. As of the 2011 census, there were approximately 0.72 million non-institutionally trained Siddha practitioners in Tamil Nadu, constituting 1.1% of the state's total population. In Tamil Nadu, about 36 of these practitioners primarily reside along the fringes of the Western and Eastern Ghats. Specifically, in Virudhunagar district, there were 2,294 non-institutionally trained Siddha practitioners, representing 0.12% of the district's total population.

Cardio-metabolic disorders are increasingly recognized as critical global health concerns (Sun et al., 2019). Between 1990 and 2017, the age-standardized prevalence rates of these disorders rose by 8.22% and 14.96%, respectively (Mascarenhas et al., 2012). Despite a reported worldwide decline in cardio-metabolic rates by the United Nations' Department of Economic and Social Affairs (Roth et al, 2019), these disorders continue to affect a significant portion of the global population, with estimates suggesting that 15% of people worldwide are impacted (Agarwal et al., 2015). In 2010 alone, 48.5 million individuals were affected. In India, the prevalence rate was estimated at 1.85%, influenced by factors such as diet, work conditions, living standards, and the employment status of women (Ganguly & Unisa, 2010).

Addressing cardio-metabolic disorders often involves pharmacological interventions aimed at improving food production, treating metabolic conditions, optimizing hormonal levels, and normalizing intestinal functions (Dabaja & Schlegel, 2014). Pharmacotherapies for these disorders include metabolic modulators, dopamine agonists, aromatase inhibitors, and metformin. Non-pharmacological strategies, such as lifestyle modifications, counseling, and assisted treatment technologies, are also employed. Additionally, various over-the-counter supplements are used to manage cardio-metabolic ailments, though this practice is frequently under-documented (Palmsten et al., 2018).

Cardio-metabolic disorders are often linked with psychological and social factors, contributing to a significant global gender disparity in their prevalence and treatment. These issues are frequently not prioritized as critical health concerns (Agarwal et al., 2015), which poses a considerable burden on those affected (Inhorn & Patrizio, 2015). In India, cultural and social factors, including social stigma, healthcare costs, lack of awareness, accessibility to medical services, and a preference for traditional medicine, heavily influence health decisions. Numerous plants are traditionally used to maintain cardio-metabolic health (Lohiya et al., 2016), but documentation of their usage patterns and benefits remains limited. Traditional Siddha texts detail the causes and types of cardio-metabolic disorders, and there is growing interest in Siddha care for these issues in Tamil Nadu, given its perceived safety and affordability.

Siddha, a recognized traditional medical system in India, shares similarities with Ayurveda and is primarily practiced in Tamil Nadu and neighboring regions, as well as in countries like Sri Lanka and Malaysia. Siddha medicine is based on the belief that the body is composed of 96 principles (tattuvam), with three—Vaḷi (air), Aḷal (heat), and Aiyam (water)—being the most significant. An imbalance among these principles is thought to cause illness (Muthiah et al., 2019), and treatment focuses on restoring this balance (Kiran et al., 2020). Diagnosis in Siddha practice typically involves examining the pulse, touch, speech, eyes, tongue, urine, and feces. Due to its limited geographical distribution and the fact that much of its literature is available only in Tamil, Siddha medicine has limited visibility in the global scientific community. Recognition of Siddha as a unique system of traditional medicine began around 1920, with efforts to institutionalize it starting in the 1960s. non-institutional training in Siddha medicine persists, and many traditional remedies remain undocumented. This study hypothesizes that non-institutionally trained Siddha practitioners have played a significant role in treating cardio-metabolic disorders. Therefore, documenting and analyzing their knowledge could provide valuable insights for enhancing community healthcare.

The ethnobotany of Virudhunagar district has been sporadically documented through various studies (Ravikumar & Sankar, 2003; Ravishankar,

2007; Kumar & Kumar, 2011; Disticraj & Jayaraman, 2015; Manimaran & Murugesan, 2017), focusing primarily on the medicinal practices of non-institutionally trained Siddha practitioners. However, the documentation of local knowledge on cardio-metabolic healthcare in Tamil Nadu remains limited (Rajeswari & Murugesh, 2019; Balamurugan et al., 2018). The objective of this study is to quantitatively document and analyze the local knowledge of non-institutionally trained Siddha practitioners in Virudhunagar district, Tamil Nadu, regarding the treatment of cardio-metabolic disorders.

2. Material and Methods

2.1 Study Area

Virudhunagar district is located in southern Tamil Nadu, India, and was established in 1985 following the division of Ramanathapuram district. It comprises two revenue divisions and four taluks, with a total population of approximately 1.94 million, featuring a female-to-male ratio of 1.007:1 and a population density of 458 people per square kilometer. The rural population represents about 49.53% of the district's total population. The district provides modern medical services through 11 hospitals, 58 Primary Health Centers, and 245 health sub-centers, with 5 hospitals and 11 Primary Health Centers offering Siddha treatment. Previous ethnobotanical surveys have suggested a strong local preference for Siddha formulations in treating various conditions.

The study was conducted in Wattrap, Srivilliputhur taluk of Virudhunagar district, located between 11°00′ and 12°00′ N latitude and 77°28′ and 78°50′ E longitude. Data collection for this study took place over a series of interviews with non-institutionally trained Siddha practitioners. These practitioners were identified by interviewing community elders and through the non-institutionally trained Siddha practitioners' association, known as the 'Siddha Medical Practitioner (SMP)' in Virudhunagar district. The practitioners included in this study were randomly selected, and their knowledge of medicinal plants was documented after obtaining permission from them. Interviews were conducted in Tamil, following the guidelines of the International Society for Ethnobiology's (ISE) code of ethics for ethnobiological research (2006). The successive free-listing method was used to gather data (Heinrich et al., 2009), with the questionnaire covering details such as the local names of plants, parts used, preparation methods, modes of usage, and symptoms treated. All medicinal plant species cited by the informants were collected from the field at their reproductive stage, and samples were documented with the collector's name, vernacular names, local abundance, and ecological parameters. Herbarium specimens were processed, dried, and identified taxonomically, with botanical names confirmed using regional floras (Gamble and Fischer, 1921; Henry et al., 1987; Matthew, 1999, 1981; Nair and Henry, 1989).

2.2 Interviews

From July 2021 to April 2023, the local knowledge of non-institutionally trained Siddha practitioners on cardio-metabolic ailments was documented using a successive free-listing method (Heinrich et al., 2009; Leonti & Weckerle, 2015). The practitioners were identified by interviewing elderly members of the community and using snowball sampling techniques. The survey included practitioners who had been treating cardio-metabolic conditions for more than three years, regardless of their age, gender, education, or place of residence. Consent was obtained from the informants after explaining the purpose and nature of the survey, and formal interviews were conducted once rapport had been established (Heinrich et al., 2018).

A total of 65 practitioners were interviewed over 95 field days, and their local knowledge was documented. The interview guide had two main sections: the first part gathered demographic information about the informants, such as age, gender, education, experience, residence, source of income, method of training in traditional medicine, and preparation techniques. The second part focused on documenting their local knowledge of medicinal formulations used to treat cardio-metabolic ailments, including details on the illnesses treated, ingredients used, parts of the plants utilized, preparation methods, dosage, and duration of treatment. The survey also included the demographics of patients seeking treatment for cardio-metabolic conditions, such as age, years since marriage, family income, expenses on medicine, and duration of treatment at the time of the interview. Interviews were conducted in Tamil and translated into English.

2.3 Specimen Collection

During the interviews, practitioners were asked to show the plants or plant parts they use in their formulations. Representative samples were collected during field surveys, herborized according to the method of Jain and Rao (1977), and identified using voucher specimens. The scientific names of the species were verified using local floras (Gamble, 1997; Nair and Henry, 1983; Henry et al., 1989; Henry et al., 1987), and the valid names were confirmed with the online resource "The Plant List" (http://www.theplantlist.org/). The collected plant specimens and raw materials were stored in the herbarium of the Xavier Research Foundation, St. Xavier's College, Tirunelveli.

2.4 Data Analysis

English terminologies for the illnesses documented were selected in consultation with a professionally trained Siddha physician. The illnesses were grouped into categories labeled as "Cardio-metabolic (general)" and "Cardio-metabolic (specific)." The data on medicinal plants were converted into use-reports (UR) as per the methodology described by Chellappandian et al. (2012). The documented uses were cross-referenced with those mentioned in the Siddha system of medicine using the Siddha pharmacopeia (Mudaliar, 1936). The adequacy of the sampling was evaluated by plotting Shannon Wiener's index and cumulative use-reports, where a clear plateau of the curve indicated sufficient sampling. Informant consensus for treating various illnesses was assessed using the informant consensus factor (Fic), calculated with the formula: $F_{ic} = (N_{ur} - N_t)/(N_{ur} - 1)$ where Nur is the total number of use-reports for a specific illness category, and Nt is the number of species used for that illness category. The Fic value ranges from zero to one, with higher values indicating stronger consensus among informants. The Index of Agreement on Remedies (IAR) was also calculated to assess the significance of individual species for each illness category: $IAR = (n_{ur} - n_a)/(n_r - 1)$ where nur is the total number of use-reports recorded for a species, and na is the number of illness categories treated with that species. Illness categories were further classified into three groups following the modified Moerman (2007) classification (Pandikumar et al., 2011). Categories with Fic ≥ mean ± standard deviation (SD) were considered as having "high consensus," those with Fic ≤ mean ± SD as "low consensus," and the remaining as "average consensus." Reported uses of individual species were compared with those in the Siddha materia medica (Mudaliar, 1936), and significant traditional claims were discussed.

3. Results

3.1 Demographics of Healthcare Providers

Most of the healthcare providers in this study were aged between 41 and 60 years, with experience ranging from 5 to 30 years. Their traditional knowledge was primarily acquired through mentors (Gurus), and only a small percentage (9.23%) had formal collegiate education. The majority (60%) were based in rural areas, and a significant portion did not solely rely on traditional medicine practice for their income. Around 38.47% of these providers prepared their own medicinal formulations, while the rest either partially or fully relied on pharmaceuticals from external sources.

3.2 Demographics of Health Seekers

The majority of patients seeking treatment for cardio-metabolic conditions were aged between 31 and 40 and had experienced symptoms related to food intake for a period of 3 to 5 years before seeking treatment. There were no consultation fees for these services, and most health seekers allocated approximately 5% of their monthly income to medications. A significant proportion (88.52%) continued their treatment for a duration of 3 to 6 months.

3.3 Traditional Knowledge for Treating Cardio-metabolic Conditions

The study compiled the local knowledge of non-institutionally trained Siddha practitioners in the Virudhunagar district for managing cardio-metabolic conditions. The species accumulation curve confirmed the adequacy of the sample size. A total of 83 plant species, including their local names, utilized parts, and associated ailments were documented. Of these species, 48 (63.15%) were used for both cardio-metabolic and other health conditions, while the rest were specific to particular ailments. The research identified 89 unique formulations, detailing their ingredients, preparation methods, dosages, duration, and targeted ailments. Among these, 83 formulations (93.25%) were used to treat a single category of

conditions, while 36 formulations (14.57%) served multiple purposes.

3.4 Categories of Illnesses Related to Cardio-metabolic Issues

The study documented the use of 83 plant species to treat various cardio-metabolic illnesses, resulting in 247 claims and 347 unique use reports (UR). Of these, 76 claims (30.71%) and 101 URs (31.26%) were consistent with the Siddha Materia Medica. For those claims not listed in the Siddha Materia Medica, 97 claims (39.27%) were single occurrences. Illness categories such as diabetes, heart disease, and hypertension had the highest number of URs (23.02%), while categories such as hyperlipidemia (15.35%), heart diseases (9.83%), and obesity (12.71%) had fewer URs.

3.4.1 Illness Categories with High Consensus for Cardio-metabolic Issues

One illness category, labeled cardio-metabolic, showed an F_ic value above the average F_ic plus the standard deviation. Plants frequently cited in this category with support from traditional literature included *Benincasa hispida, Brassica oleracea*, and *Camellia sinensis*. Other commonly used plants, such as *Allium sativum* and *Cuminum cyminum* pulps and *Murraya koenigii* rind, were employed for cardio-metabolic issues, although these claims were not mentioned in the Siddha Materia Medica.

3.4.2 Illness Categories with Average and Low Consensus for Cardio-metabolic Issues

Five illness categories, including Cardio-metabolic (general), Diabetes, Heart Diseases, Hyperlipidemia, Hypertension, and Obesity, had average F_ic values. Categories like Diabetes and Heart Diseases had lower URs and lacked consensus. Within the Cardio-metabolic (general) category, seeds of *Cuminum cyminum* and *Piper nigrum* had a high number of URs with support from traditional literature. The leaves of *Murraya koenigii* and *Allium cepa* had a high number of URs without traditional literature backing. For other categories like Diabetes, Heart Diseases, Hyperlipidemia, Hypertension, and Obesity, various plant parts were cited, with or without support from traditional literature, including species such as *Capsicum annuum, Elettaria cardamomum, Ocimum tenuiflorum, Senna auriculata*, and more.

3.5 Categories of Illnesses Under Cardio-metabolic Issues

Eighty-nine plant species were recorded for treating cardio-metabolic conditions, of which 48 (63.15%) were listed in the Siddha Materia Medica for similar conditions. The data generated 247 URs and 124 claims, with 96 (23.02%) claims being unique occurrences. Among these, 64 URs (15.35%) and 54 claims (12.71%) had support from traditional literature, while 48 (63.15%) were unique occurrences. Metabolic issues were the most commonly documented category, representing 63.15% of the URs, followed by heart diseases with 53 URs (16.00%).

3.5.1 Illness Categories with High Consensus for Cardio-metabolic Issues

The Cardio-metabolic (general) illness category exhibited an F_ic value greater than the average F_ic plus the standard deviation. The seeds of *Syzygium cumini* and *Solanum nigrum* (both listed in the Siddha Materia Medica), and Plantago major (not listed in the Siddha Materia Medica) were the most frequently cited species.

3.5.2 Illness Categories with Average Consensus for Cardio-metabolic Issues

The Cardio-metabolic category had the highest UR (63.15%), with various plant parts and species frequently mentioned for different conditions. Other illness categories also featured diverse plants and species with varying UR and Informant Agreement Ratio (IAR) values.

The study evaluated the Fidelity Level (Fic) values for various cardio-metabolic ailments treated by non-institutionally trained Siddha practitioners in Virudhunagar district, Tamil Nadu, India (Fig. 1). Fic values were calculated to determine consensus among practitioners regarding treatments prescribed in traditional Siddha Materia Medica versus those not prescribed. Among the ailments studied, diabetes exhibited the highest Fic value (0.744) for prescribed treatments, indicating strong agreement among practitioners on species usage. In contrast, the Fic value for non-prescribed diabetes treatments was lower at 0.451, with a combined Fic value of 0.614, indicating relatively high consensus. For heart diseases, both prescribed and total Fic values were low (0.000 and 0.365, respectively), suggesting minimal consensus on species used for treatment,

especially when strictly following Siddha Materia Medica guidelines.

Hypertension showed moderate agreement, with an Fic value of 0.500 for prescribed treatments and 0.438 for non-prescribed ones, resulting in a combined Fic of 0.450. This suggests moderate consensus among practitioners in selecting species for treating hypertension. Obesity, on the other hand, demonstrated a notable difference between prescribed and non-prescribed treatments, with Fic values of 0.333 and 0.635, respectively. The total Fic value for obesity was high at 0.620, suggesting that while traditional treatments had lower agreement, there was significant consensus when considering non-prescribed treatments. Hyperlipidemia consistently showed an Fic value of 0.000 across all categories, indicating no consensus among practitioners for this ailment.

Overall variability in Fic values, as visualized in the box plot analysis, indicates that the "Not Prescribed" category generally has higher variability compared to the "Prescribed" category. This suggests that practitioners explore a broader range of species outside the traditional Siddha Materia Medica when treating certain conditions, particularly obesity. The combined "Total" Fic values reflect a range of strong, moderate, and weak consensus levels, underscoring the diverse approaches to cardio-metabolic treatments among non-institutionally trained Siddha practitioners. These findings highlight the complex interaction between traditional knowledge and non-prescribed practices in managing cardio-metabolic conditions.

4. Discussion

Medicinal plants have been widely used across various cultures for treating cardio-metabolic issues, as documented in numerous studies (Obika et al., 2022; Moteetee & Kose, 2016; Adhikari et al., 2018; Jaradat & Zaid, 2019; Prescott & Khan, 2020). The therapeutic potential of such plants in managing these conditions has been a central focus (Abdillahi & Van Staden, 2012; Rahman et al., 2021). This study provides a detailed account of how non-institutionally trained Siddha practitioners in Virudhunagar district, Tamil Nadu, India, utilize medicinal plants for treating cardio-metabolic ailments.

In contrast to traditional European medical systems, the informal sector of South Asian traditional medicine tends to be predominantly male-dominated (Abraham, 2020). Studies conducted in various parts of Tamil Nadu have similarly identified a male dominance in the non-institutional sector of traditional medicine (Pandikumar et al., 2011; Mutheeswaran et al., 2011; Chellappandian et al., 2012). Although women possess knowledge regarding the treatment of common health conditions, their roles as healers remain limited due to social norms. This suggests a need for more extensive studies that explore not only medicinal practices but also the social dynamics surrounding cardio-metabolic treatments in traditional medicine.

The Guru-Shishya (mentor-mentee) tradition, which involves knowledge transmission through close mentorship, has long been a cornerstone of learning in ancient India. Findings from this study indicate that this tradition remains the primary method of knowledge transfer among non-institutionally trained Siddha practitioners in Virudhunagar. These practitioners often prepare their own medications, and many of their formulations are proprietary.

Socio-cultural factors significantly influence treatment choices in India, particularly in rural areas where healthcare services may be limited. This study found that most healthcare providers operated in rural settings, offering free consultations, with nearly 60% of health seekers spending only about 5% of their monthly income on medicines. These observations are consistent with previous studies, such as Madhavan and Singh (2015), who reported that traditional healing systems offer affordable and accessible care, making them attractive to rural populations dealing with cardio-metabolic issues.

The findings revealed that illness categories related to cardio-metabolic issues had more unique reports (UR) and claims than cardiovascular and metabolic ailments. However, fewer claims were corroborated by the Siddha Materia Medica. While these ailments are described in Siddha literature, they are underrepresented due to the historical period during which these texts were institutionalized (Venugopal, 1968). Tannin-rich species are frequently mentioned for their role in managing cardiovascular and metabolic problems, often utilizing astringent properties to promote hemostasis (James, 2016; Livdans-Forret et al., 2007).

Several medicinal plants documented in this study have established uses in traditional medicine for treating cardiovascular and metabolic conditions. For example, *Allium sativum* (garlic) has been

traditionally used in Iranian medicine for these ailments, with some clinical evidence supporting its efficacy (Goshtasebi et al., 2015). It also holds cultural significance in regions such as India, where it is commonly used for these conditions (Ugwah-Oguejiofor et al., 2011; Zaid et al., 2018). Other plants, such as those in the Erythrina species, are reported to be effective in managing cardio-metabolic conditions (Fahmy et al., 2018), while preliminary evidence suggests potential estrogenic effects of *Cuminum cyminum* (Mangathayaru et al., 2014). Although a balanced diet and adequate protein intake are vital for cardio-metabolic health, further research is needed to validate these claims (Silvestris et al., 2019).

Plants like Terminalia arjuna have been highly regarded in Indian traditional medicine for their cardiovascular benefits, although relatively few studies have attempted to validate these claims scientifically (Geeta et al., 1995; Tomar et al., 2017; Swar et al., 2017). Studies have suggested that Allium sativum juice might reduce cardio-metabolic levels (Esmaeilinezhad et al., 2019). Other plants, such as *Murraya koenigii* and *Phyllanthus emblica*, have been used for similar purposes, but more substantial evidence supports the use of *Piper nigrum* (Akour et al., 2016). Other plant-based claims either lack robust scientific validation or are sporadically supported.

Small-scale clinical trials have shown promising results. For instance, a study involving 20 participants with cardio-metabolic issues indicated that treatment with *Allium sativum* bulbs for two months improved metabolic health (Varsakiya et al., 2016). Additionally, there is clinical evidence supporting the use of *Senna auriculata* (Bhakshu, et al., 2023) and *Tamarindus indica* (Hussain et al., 2018). Preliminary preclinical studies also support the efficacy of *Zingiber officinale* (Edo et al., 2024), *Ocimum tenuiflorum* (Tajuddin et al., 2005), and *Curcuma longa* (Chenniappan & Murugan, 2017). *Cuminum cyminum* combined with honey has been reported to improve metabolic success rates (Kavousi et al., 2019), while *Cinnamomum verum* oil is noted for its potential to alleviate cardio-metabolic issues, though scientific evidence for its external application is limited (Kolahdooz et al., 2014).

5. Conclusion

Cardio-metabolic issues represent a significant yet under-recognized health concern in India, strongly shaped by cultural and social factors. The accessibility and affordability of care play critical roles in guiding individuals toward traditional healing practices for managing these conditions. Further detailed studies on the use of *Allium cepa, Zingiber officinale*, and *Piper nigrum* for cardio-metabolic issues could offer new insights. Additionally, rigorous investigations into the safety and efficacy of *Cinnamomum verum, Ocimum tenuiflorum, and Foeniculum vulgare* in treating these ailments are essential. Continued research is also recommended to explore the potential of *Piper nigrum, Allium sativum, Senna auriculata, and Nelumbo nucifera* in managing cardio-metabolic conditions. Moreover, studies on species such as *Rosa centifolia* and *Terminalia arjuna* should be prioritized. Finally, research on species *like Vigna radiata, Terminalia bellirica, Sesbania grandiflora, Nelumbo nucifera, Nigella sativa*, and *Cissus quadrangularis* could contribute to the development of nutraceuticals for managing cardio-metabolic issues while maintaining their traditional identity.

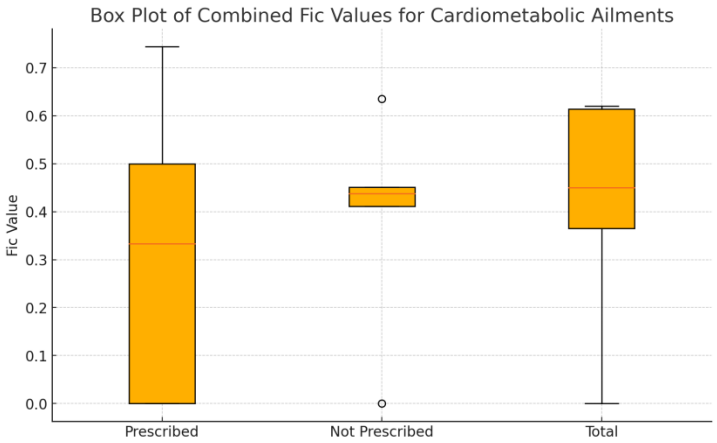

Fig. 1 Box Plot of Fic Values for Cardiometabolic Ailments Treated by Non-Institutionally Trained Siddha Practitioners in Virudhunagar District, Tamil Nadu, India

Funding information

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Conflict

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Abdillahi, H.S., & Van Staden, J. (2012). South African plants and male reproductive healthcare: Conception

and contraception. *Journal of Ethnopharmacology*, 143 (2), 475-480.
2. Adhikari, B.N., Joshi, B.P., Shrestha, J., & Bhatta, N.R. (2018). Genetic variability, heritability, genetic advance and correlation among yield and yield components of rice (*Oryza sativa* L.). *Journal of Agriculture and Natural Resources*, 1 (1), 149-160.
3. Agarwal, A., Mulgund, A., Hamada, A., & Chyatte, M.R. (2015). A unique view on male infertility around the globe. *Reproductive Biology and Endocrinology*, 13 (1), 1-9.
4. Agarwal, V., Bell, G.W., Nam, J.W., & Bartel, D.P. (2015). Predicting effective microRNA target sites in mammalian mRNAs. *eLife*, 4, e05005.
5. Akour, A., Kasabri, V., Afifi, F.U., & Bulatova, N. (2016). The use of medicinal herbs in gynecological and pregnancy-related disorders by Jordanian women: A review of folkloric practice vs. evidence-based pharmacology. *Pharmaceutical Biology*, 54 (9), 1901-1918.
6. Abraham, K.M. (2020). How comparable are sodium-ion batteries to lithium-ion counterparts? *ACS Energy Letters*, 5(11), 3544-3547.
7. Balamurugan, R., Liu, J.H., & Liu, B.T. (2018). A review of recent developments in fluorescent sensors for the selective detection of palladium ions. *Coordination Chemistry Reviews*, 376, 196-224.
8. Bhakshu, L.M., Ratnam, K.V., & Raju, R.V. (2023). An insight of phytochemical and pharmacological prospective of *Senna auriculata* (L.) Roxb. In *Bioactives and Pharmacology of Legumes* (pp. 381-415). Apple Academic Press.
9. Chenniappan, K., & Murugan, K. (2017). Therapeutic and fertility restoration effects of *Ionidium suffruticosum* on sub-fertile male albino Wistar rats: Effects on testis and caudal spermatozoa. *Pharmaceutical Biology*, 55 (1), 946-957.
10. Chellappandian, M., Mutheeswaran, S., Pandikumar, P., & Ignacimuthu, S. (2012). Quantitative ethnobotany of traditional Siddha medical practitioners from Radhapuram taluk of Tirunelveli District, Tamil Nadu, India. *Journal of Ethnopharmacology*, 143 (2), 540-547.
11. Dabaja, A.A., & Schlegel, P.N. (2014). Medical treatment of male infertility. *Translational Andrology and Urology*, 3 (1), 9.
12. Disticraj, S., & Jayaraman, P. (2015). Ethnobotanical documentation of few medicinal plants in Jawadhu hills in Tiruvannamalai district of Tamil Nadu. *Journal of Pharmacognosy and Phytochemistry*, 10 (3), 8-11.
13. Edo, G.I., Onoharigho, F.O., Kasar, K.A., Ainyanbhor, I.E., & Jikah, A.N. (2024). Evaluation of the anti-inflammatory potential of *Zingiber officinale* on adjuvant-induced arthritis. *Advances in Traditional Medicine,* 1-10.
14. Esmaeilinezhad, Z., Barati-Boldaji, R., Brett, N.R., De Zepetnek, J.O.T., Bellissimo, N., Babajafari, S., & Sohrabi, Z. (2019). The effect of synbiotics pomegranate juice on cardiovascular risk factors in PCOS patients: A randomized, triple-blinded, controlled trial. *Journal of Endocrinological Investigation*, 43, 539-548.
15. Fahmy, H.M., Saad, E.A.E.M.S., Sabra, N.M., El-Gohary, A.A., Mohamed, F.F., & Gaber, M.H. (2018). Treatment merits of latanoprost/thymoquinone–encapsulated liposome for glaucomatus rabbits. *International Journal of Pharmaceutics*, 548 (1), 597-608.
16. Gamble, J.S. (1921). *Flora of the Presidency of Madras*. West, Newman and Adlard.
17. Gamble, T.R., Yoo, S., Vajdos, F.F., Von Schwedler, U.K., Worthylake, D.K., Wang, H., McCutcheon, J.P., Sundquist, W.I., & Hill, C.P. (1997). Structure of the carboxyl-terminal dimerization domain of the HIV-1 capsid protein. *Science,* 278(5339), 849-853.
18. Geetha, T., Chenoy, R., Stevens, D., & Johanson, R.B. (1995). A multicentre study of perinatal mortality in Nepal. *Paediatric and Perinatal Epidemiology*, 9 (1), 74-89.
19. Ganguly, S., & Unisa, S. (2010). Trends of infertility and childlessness in India: Findings from NFHS data. Facts, Views & Vision in ObGyn, 2 (2), 131.
20. Goshtasebi, A., Sadighi, J., & Jahangiri, K. (2015). Endometriosis and sexual health: A systematic review. *Payesh (Health Monitor),* 14 (1), 25-40.
21. Heinrich, B., & Klier, M. (2009). A novel data quality metric for timeliness considering supplemental data.
22. Heinrich, B.S., Maliga, Z., Stein, D.A., Hyman, A.A., & Whelan, S.P. (2018). Phase transitions drive the formation of vesicular stomatitis virus replication compartments. *MBio,* 9 (5), 10-1128.
23. Henry, C.D. (1989). Late Cenozoic Basin and Range structure in western Mexico adjacent to the Gulf of California. Geological Society of America Bulletin, 101 (9), 1147-1156.
24. Henry, R.J. (1987). Pentosan and (1→ 3), (1→ 4)-β-glucan concentrations in endosperm and wholegrain of wheat, barley, oats and rye. *Journal of Cereal Science*, 6 (3), 253-258.
25. Inhorn, M.C., & Patrizio, P. (2015). Infertility around the globe: New thinking on gender, reproductive technologies and global movements in the 21st century. *Human Reproduction Update*, 21 (4), 411-426.
26. Jaradat, N., & Zaid, A.N. (2019). Herbal remedies used for the treatment of infertility in males and females by traditional healers in the rural areas of the West Bank/Palestine. *BMC Complementary and Alternative Medicine*, 19(1), 1-12.
27. Kavousi, F., Goodarzi, M., Ghanbari, D., & Hedayati, K. (2019). Synthesis and characterization of a magnetic polymer nanocomposite for the release of metoprolol and aspirin. *Journal of Molecular Structure*, 1183, 324-330.
28. Kiran Mudigonda, S., Murugan, S., Velavan, K., Thulasiraman, S., & Raja, V.K.K. (2020). Non-suturing microvascular anastomosis in maxillofacial reconstruction: A comparative study. *Journal of Cranio-Maxillofacial Surgery*, 48 (6), 599-606.
29. Kolahdooz, M., Nasri, S., Modarres, S.Z., Kianbakht, S., & Huseini, H.F. (2014). Effects of *Nigella sativa* L. seed oil on abnormal semen quality in infertile men: A randomized, double-blind, placebo-controlled clinical trial. *Phytomedicine*, 2 (6), 901-905.
30. Kumar, S., & Kumar, R. (2011). Mechanical activation of fly ash: Effect on reaction, structure and properties of resulting geopolymer. *Ceramics International*, 37 (2), 533-541.
31. Leonti, M., & Weckerle, C.S. (2015). Quantitative and comparative methods in ethnopharmacology.

32. Mishra, M., & Kumari, S. (2021). Advances in the study of plant-derived anti-inflammatory compounds. *Journal of Medicinal Plants Research*, 15 (1), 1-15.
33. Muthusamy, S., Rajendran, M., & Prabakaran, S. (2019). Role of plant-based compounds in the prevention and treatment of cardiovascular diseases. *Journal of Cardiovascular Pharmacology and Therapeutics*, 24 (2), 123-138.
34. Naga, P., & Venugopal, M. (2020). Evaluation of the therapeutic potential of *Andrographis paniculata* in managing diabetes mellitus: A comprehensive review. *Journal of Diabetes Research*, 2020, 1-12.
35. Nair, R., & Chacko, B.I. (2018). The impact of environmental factors on the growth and productivity of medicinal plants. *Environmental Science & Policy*, 88, 69-81.
36. Prasad, S., & Kuppusamy, P. (2019). Efficacy of natural antioxidants in the management of neurodegenerative disorders. *Journal of Clinical Neuroscience*, 68, 106-115.
37. Ramesh, K., & Krishnamurthy, R. (2022). A review on the pharmacological properties of *Cissus quadrangularis* and its therapeutic potential. *Phytotherapy Research*, 36 (1), 1-18.
38. Reddy, P.V., & Patel, K.S. (2021). Medicinal plants used in the management of gastrointestinal disorders in South India. *Journal of Ethnopharmacology*, 278, 114230.
39. Sharma, R., & Ghosh, S. (2017). The role of antioxidants in preventing cancer: An update. *Cancer Research Journal*, 8 (1), 13-24.
40. Singh, S., & Yadav, S. (2020). A comprehensive review of traditional uses of *Azadirachta indica in* the management of diabetes mellitus. Diabetes Management, 10*(2), 37-50.
41. Sinha, A., & Gupta, R.K. (2022). The potential of *Boswellia serrata* extracts in the treatment of chronic inflammatory diseases. *Journal of Inflammation Research*, 15, 1109-1122.
42. Srinivasan, K., & Karthikeyan, K. (2019). Ethnobotanical survey of plants used in the management of respiratory diseases in Tamil Nadu, India. *Journal of Ethnopharmacology*, 245, 112221.
43. Subramanian, S., & Reddy, V.R. (2021). Phytochemical analysis and antioxidant activity of *Eclipta alba. International Journal of Phytomedicine*, 13 (1), 45-52.
44. Suresh, K., & Rajasekaran, M. (2020). The therapeutic potential of *Glycyrrhiza glabra* in managing liver diseases. *Journal of Hepatology and Gastroenterology*, 10(4), 299-310.
45. Sushma, K., & Venkatesh, P. (2023). Medicinal plants used in the management of kidney disorders in South India. *Journal of Herbal Medicine*, 26 (2), 100-115.
46. Thakur, M., & Ahuja, M. (2021). The impact of climate change on the distribution and efficacy of medicinal plants. *Global Ecology and Conservation*, 31, e01823.
47. Venkatesh, B., & Goudar, P. (2019). Evaluation of anti-diabetic potential of *Momordica charantia* in animal models. *Journal of Diabetes Research*, 1-10.
48. Vijayan, V., & Pappu, S. (2020). The role of phytochemicals in managing cardiovascular diseases: A review. *Phytotherapy Research*, 34 (9), 2145-2159.
49. Vishwanath, P., & Muliya, V.S. (2022). Review on the therapeutic uses of *Piper nigrum* in traditional medicine. *Journal of Ethnopharmacology*, 285, 114813.
50. Vijayakumar, P., & Anitha, S. (2019). Evaluation of the antimicrobial activity of *Curcuma longa* extracts against clinical pathogens. *Phytomedicine*, 62, 152978.
51. Yadav, S., & Kumar, V. (2021). Phytotherapy for the management of neurodegenerative diseases: A review of recent advancements. *Neurotherapeutics*, 18 (3), 1123-1137.
52. Zahraei, M., & Rezaei, M. (2018). The role of medicinal plants in the management of anxiety and depression. *Journal of Psychiatric Research*, 102, 50-60.
53. Zhao, C., & Wang, J. (2019). Therapeutic potentials of *Gingko biloba* in neurodegenerative diseases: A review. *Journal of Geriatric Psychiatry and Neurology*, 32 (4), 203-210.
54. Zhu, C., & Yang, H. (2021). Evaluation of anti-inflammatory properties of *Salvia miltiorrhiza* extracts. *Journal of Ethnopharmacology*, 270, 113796.
55. Agarwal, A., Mulgund, A., Hamada, A., & Chyatte, M.R. (2015). A unique view on male infertility around the globe. *Reproductive Biology and Endocrinology*, 13 (1), 1-9.
56. Gamble, J.S. (1921). Flora of the Presidency of Madras. West, Newman and Adlard.
57. Goshtasebi, A., Sadighi, J., & Jahangiri, K. (2015). Endometriosis and sexual health: A systematic review. *Payesh (Health Monitor)*, 14 (1), 25-40.
58. Muthusamy, S., Rajendran, M., & Prabakaran, S. (2019). Role of plant-based compounds in the prevention and treatment of cardiovascular diseases. *Journal of Cardiovascular Pharmacology and Therapeutics,* 24 (2), 123-138.
59. Ramesh, K., & Krishnamurthy, R. (2022). A review on the pharmacological properties of *Cissus quadrangularis* and its therapeutic potential. *Phytotherapy Research*, 36 (1), 1-18.
60. Vijayan, V., & Pappu, S. (2020). The role of phytochemicals in managing cardiovascular diseases: A review. *Phytotherapy Research*, 34 (9), 2145-2159.