*Original Research Article*

Livelihood Security of Women Farmers in High Range Agroclimatic zone of Kerala: A Critical Gender Analysis

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ABSTRACT

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| **Aims:** Women farmers in high altitudes of Kerala play a vital role in sustaining local agriculture, yet their livelihood conditions often remain overlooked in government development policies and research initiatives. This study focuses on assessing the livelihood security of women farmers in the high range agroclimatic zone of Kerala. Specifically, Idukki district was selected for its unique geographic and socio-economic characteristics.  **Study design:** Ex-post facto research  **Place and Duration of Study:** The study has been conducted in the high range agroclimatic zone of Kerala from 2022 to 2024, specifically in Idukki district, selected for its unique geographic and socio-economic characteristics.  **Methodology:** A total of 48 women farmers were selected from six gram panchayats of Idukki district by following simple random sampling to ensure broad representation of farming households. To evaluate their well-being, a multi-dimensional Livelihood Security Index was developed incorporating five key dimensions such as food security, occupational security, educational security, health security, and social security. The index was constructed using Principal Component Analysis to ensure meaningful aggregation of variables.  **Results:** Findings revealed that 50.00 per cent of the women farmers in Idukki were categorized under low livelihood security, 39.58 per cent under medium, and only 10.42 per cent under high category. The results underscore the vulnerability of women farmers in hilly regions, where access to resources, infrastructure, and support systems is often limited. Statistically significant associations were observed between livelihood security and factors such as educational qualification, land ownership, social participation, mass media exposure, and extension contact.  **Conclusion:** The study highlights the need for targeted, gender-sensitive interventions that address the specific challenges of women farmers in high-altitude areas. Enhancing access to education, information, and institutional support can strengthen rural livelihoods and promote inclusive development. |

*Keywords: Gender sensitive interventions; High Range zone of Kerala; Women farmers; Livelihood security*

1. INTRODUCTION

Women play a significant role in sustaining rural livelihoods through their contributions to agriculture and allied activities (Rani *et al*., 2022). In many regions, particularly in ecologically sensitive and geographically remote areas, their role becomes even more critical, as they manage household food production, take care of livestock, and participate in community level livelihood activities. Despite their contribution, women farmers often face multiple challenges in securing sustainable livelihoods due to limited access to resources, services, and decision-making opportunities. These challenges are more severe in high-altitude areas where physical isolation and difficult terrain further restrict access to basic services and institutional support.

In India, the feminization of agriculture has emerged as a growing phenomenon, with an increasing number of women assuming active roles in farming, especially in regions affected by male migration (Pingali *et al*., 2019). Yet, these women continue to remain invisible in official statistics and are often denied ownership of land and productive assets, which are central to livelihood security (FAO, 2011). In the hill regions of Uttarakhand and Himachal Pradesh, studies have shown that women take on most of the agricultural tasks but remain excluded from agricultural planning and policy benefits (Bordoloi, 2021).

The situation in Kerala, though considered progressive in terms of human development indicators, reflects gender disparities in agricultural livelihoods. In districts like Idukki, where the topography is marked by steep slopes and fragmented holdings, women are crucial in agricultural production. However, their efforts are often constrained by lack of access to land, credit, extension services, and market linkages. In such areas, the livelihoods of women farmers are not only shaped by socio-cultural barriers but also by the region’s environmental fragility and infrastructural limitations.

In Kerala, *Kudumbashree* mission have significantly contributed to improving the economic status of women, the outreach and impact of such initiatives are often uneven in hilly and remote areas (Devika, 2016). Women in plantation dominated districts like Idukki, where cardamom, tea, and pepper cultivation are widespread, continue to face precarious working conditions and are largely confined to unorganized sectors. Their livelihood security is closely linked to seasonal employment patterns and fluctuating market prices, making it unstable and vulnerable to external shocks.

Understanding the livelihood security of women in high altitude zones such as Idukki requires an integrated approach that acknowledges the interplay between gender, geography, and socio-economic structures. The multiple deprivations experienced by women in these settings demand attention not only from a welfare perspective but as part of a broader developmental imperative. Women’s ability to contribute meaningfully to agriculture and to ensure food and nutritional security for their families is closely tied to their access to land, knowledge, credit, healthcare, and supportive social networks. Addressing these dimensions collectively can lead to more inclusive, resilient, and sustainable rural livelihoods across Kerala’s high ranges and similar agro-climatic regions.

2. methodology

The study was conducted in Idukki district, which was randomly selected to represent the high-range agroclimatic zone of Kerala. From the district, three block panchayats characterized by high agricultural activity were purposively selected based on their cropping intensity (Table 1). Subsequently, two gram panchayats were chosen from each selected block panchayat using the same criterion. A random sample of eight women farmers from each gram panchayat was selected to form the study respondents.

Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s Test of Sphericity was conducted to test the suitability of data for Exploratory Factor Analysis (EFA). To develop a composite index, Principal Component Analysis (PCA) was employed.

In addition to index construction, a Spearman rank correlation analysis was carried out to examine the association between selected socio-economic characteristics of women farmers and their livelihood security levels. This non-parametric method was chosen due to the ordinal nature of the livelihood security index and the distribution of the socio-economic variables. The correlation analysis helped to identify key personal and structural factors that significantly influenced the livelihood security of women farmers in Idukki district.

The challenges encountered by the women farmers were systematically analysed using the Garrett Ranking technique to identify and prioritize the major challenges based on their perceived severity.

The ranks assigned to each identified challenge by the respondents were converted into percentage positions using the following formula:

Percent Position = 100 × (Rij – 0.5) / Nj

Where:

Rij denotes the rank assigned to the ith item by the jth respondent

Nj represents the total number of items ranked by the jth respondent

The resulting percentage positions were then translated into corresponding scores using Garrett’s Conversion Table. These scores, obtained from all respondents for each constraint, were aggregated to derive the total score for each item. Subsequently, the mean score for each constraint was computed to determine its relative severity. The constraint with the highest mean score was considered the most critical, and all other items were ranked in descending order of their mean scores, with the most severe challenge receiving the top rank.

**Table 1. List of block panchayats and gram panchayats selected for the study based on cropping intensity**

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| --- | --- | --- |
| **Sl. No** | **Block Panchayat with cropping intensity\*** | **Gram Panchayat with cropping intensity\*** |
| 1. | Nedumkandam (154.19%) | 1. Nedumkandam (153.89%) |
| 2. Karunapuram (150.41%) |
| 2. | Adimali (142.29%) | 1. Adimali (141.39%) |
| 2. Pallivasal (139.68%) |
| 3. | Kattappana (126.81%) | 1. Vandanmedu (123.19%) |
| 2. Kanchiyar (121.26%) |

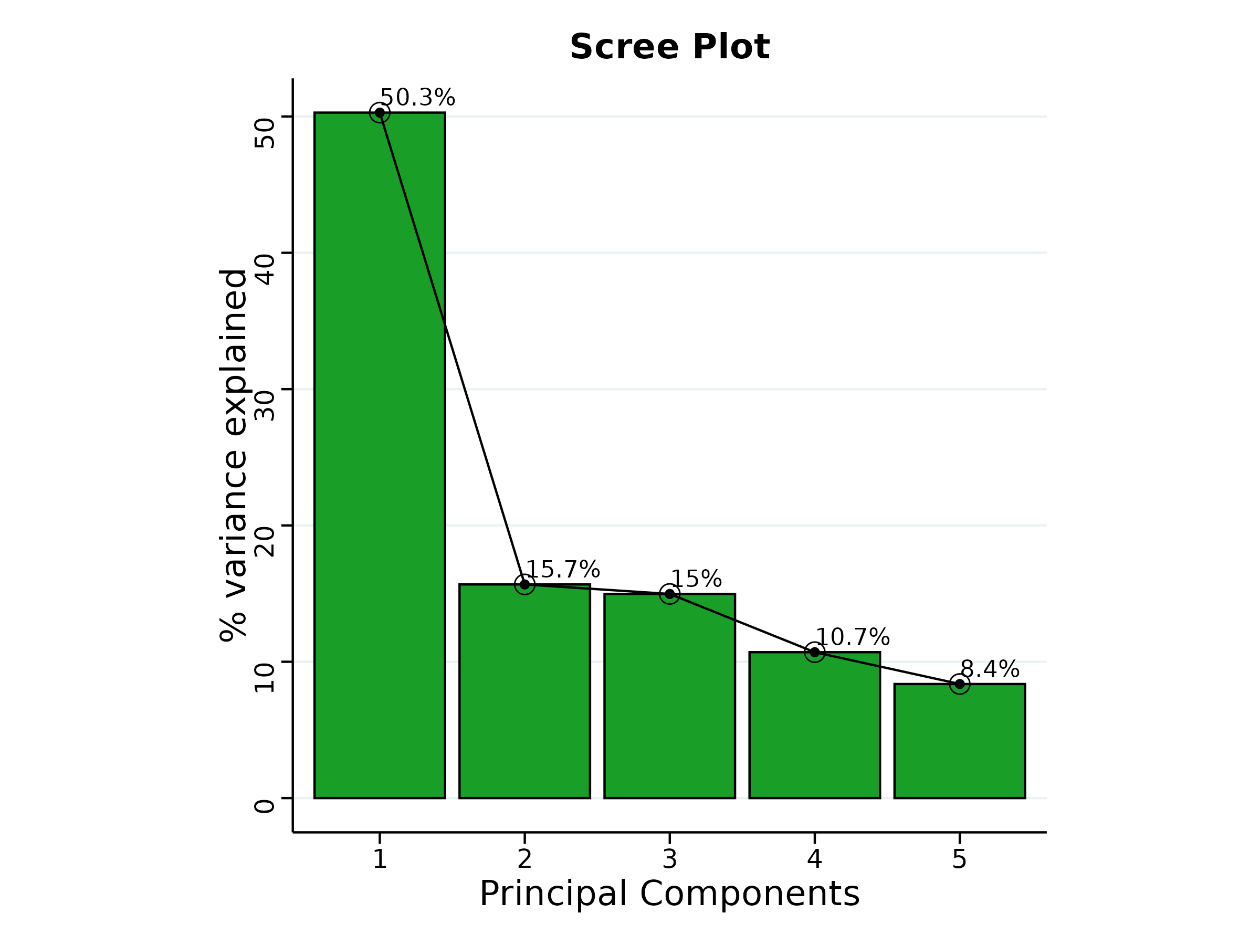
\*Cropping intensity derived from Agricultural Census 2016 and Dept. of Agriculture and Farmers Welfare (Krishi bhavan) basic data

The statistical analysis platform RAISINS (R and AI Solutions for INferential Statistics) was utilized for conducting the Kaiser-Meyer-Olkin (KMO) test, Bartlett’s test of sphericity, principal component analysis, exploratory factor analysis, and the garret ranking method.

3. results and discussion

To assess the livelihood security of women farmers in Idukki district, a Livelihood Security Index (LSI) was constructed by adapting the framework developed by Mishra and Debata (2021) to reflect the contextual realities of women engaged in agriculture in the high-altitude zone of Kerala.

Before performing the factor analysis, the adequacy of the data was verified through the KMO measure and Bartlett’s Test of Sphericity. The KMO test yielded a value of 0.781, indicating that the sample was suitable for factor analysis. The Bartlett’s Test was also found to be significant (Chi-square = 347.76, *p* < 0.001), confirming that sufficient correlations existed among the variables for conducting EFA.

Following these preliminary checks, an EFA was conducted using the principal axis factoring method with Varimax rotation. The analysis revealed two key underlying factors. Based on their factor loadings, five variables such as occupational security, educational security, social security, health security, and food security were retained, as they contributed significantly to explaining the construct of livelihood security. Other dimensions such as environmental and habitat security had low factor loadings and were excluded from further analysis due to their limited explanatory power. To develop a composite index, PCA was employed using the five retained dimensions. The first principal component emerged as the most significant, explaining 50.28 per cent of the total variance (Fig.1). This component showed strong positive loadings across all selected variables, making it an appropriate basis for constructing the index.

**Fig. 1 Scree plot showing the variance explained by principal components**

For each respondent, the index score was calculated using the standardized scores of the five variables, weighted by their respective loadings on the first principal component. The resulting score represented the overall livelihood security status of each woman farmer.

To classify respondents into low, medium, and high livelihood security groups, a statistical classification method based on the mean ± standard deviation was applied, maintaining an 80 per cent confidence level. This approach enabled a meaningful categorization of women farmers in Idukki district based on their composite livelihood security scores and provided insights into regional disparities and areas requiring targeted intervention.

The analysis of livelihood security among women farmers in Idukki district revealed that 50.00 per cent of the respondents were categorized under low livelihood security, while 39.58 per cent were in the medium category. Only 10.42 per cent of the women attained high livelihood security (Table 2 and Fig.2). This distribution suggests a skewed scenario in which a majority of women farmers remain at the lower end of the livelihood spectrum, with limited access to critical resources and services necessary for ensuring a secure and sustainable living.

**Table 2. Frequency and percentage distribution of women farmers based on LSI scores (N=48)**

|  |  |  |
| --- | --- | --- |
| **Categories\*** | **Frequency** | **Percentage** |
| Low (<0.269715) | 24 | 50.00 |
| Medium (0.269715-0.591962) | 19 | 39.58 |
| High (>0.591962) | 5 | 10.42 |

\*Mean ± Standard Deviation at 80% confidence interval

**Fig. 2 Percentage distribution of women farmers based on LSI scores**

The low representation of women in the high security category highlights the layered vulnerabilities faced by women in Idukki’s plantation and spice based agricultural economy. Unlike low-lying districts where smallholder food cropping may be more common, agriculture in Idukki is largely oriented around the cultivation of high value crops such as cardamom, pepper, and tea. While these crops have commercial potential, women often participate as casual labourers in family run plantations or as hired workers in estates, with limited access to income, ownership rights, or bargaining power. The livelihood security of women in this region is further challenged by the seasonal and volatile nature of income from plantation crops. Crop yields in high-altitude regions are heavily dependent on climatic conditions (Southard and Randell, 2022), and fluctuations in market prices for spices can drastically affect household income stability. This economic uncertainty, coupled with the absence of structured support systems, restricts women's capacity to invest in healthcare, education, and improved living standards.

Another contributing factor to the low security levels is the limited outreach of government development schemes in hilly terrains like Idukki. Physical inaccessibility and fragmented settlements impede the delivery of services such as health care, agricultural extension, and educational programmes. This has a direct impact on the ability of women to access entitlements and livelihood-enhancing interventions.

Moreover, the dual burden of plantation work and household responsibilities leaves women with little time or opportunity to pursue alternative income generating activities. The gendered division of labour restricts their mobility and participation in community-based initiatives that could otherwise strengthen their social capital and access to resources (Eswarappa, 2020). Lack of representation in producer organizations and agricultural cooperatives further weakens their position in the value chain of high-value crops like cardamom and pepper.

The findings from Idukki emphasize the need for district-specific, gender-responsive livelihood interventions. Enhancing women’s livelihood security in this region requires not only better access to land and resources but also targeted institutional support tailored to the plantation sector. Strengthening women's roles in marketing cooperatives, providing price risk insurance for spice crops, and ensuring their representation in planning and extension systems are critical for transforming their economic status and improving overall livelihood outcomes.

The association between selected socio-economic characteristics and the livelihood security of women farmers in Idukki district was examined using Spearman rank correlation (Table 3). The results revealed that several variables exhibited statistically significant positive relationships, indicating their potential role in enhancing the livelihood conditions of women in the high-altitude context of Idukki.

Among the variables assessed, mass media exposure showed the highest degree of positive correlation (r = 0.686), reflecting the critical influence of access to information in strengthening livelihood outcomes. Women who are regularly exposed to agricultural content through television, radio, newspapers, or mobile platforms are more likely to make informed decisions, access schemes, and adopt new technologies that contribute to greater livelihood stability. This observation is consistent with earlier findings that emphasized the role of mass communication tools in improving women’s knowledge, decision-making, and overall productivity (Das and Chowdhury, 2024).

Social participation also showed a strong and significant correlation (r = 0.549), underscoring the value of community engagement in facilitating livelihood enhancement. Women who are active in self-help groups, farmers’ collectives, or local governance bodies are more likely to receive institutional support, training opportunities, and access to government interventions. These platforms also enhance women's voice in decision-making and resource allocation, which has been widely recognized as a pathway to improved socio-economic well-being.

**Table 3. Spearman rank correlation between socio-economic characteristics and livelihood security of women farmers (N=48)**

|  |  |
| --- | --- |
| **Socio-economic characteristics** | **Correlation coefficient** |
| **1. Demographic variables** | |
| Age | 0.003 |
| Type of region | 0.268 |
| Marital status | 0.005 |
| Educational qualification | 0.414\*\* |
| Type of family | 0.106 |
| **2. Socio-economic variables** | |
| Annual income | 0.475\*\*\* |
| % of annual income from agriculture & allied field | 0.128\* |
| Land holdings (in acres) | 0.226\*\* |
| Ownership of land | 0.198 |
| Possession of implements | 0.051 |
| Extension contacts | 0.447\*\* |
| Social participation | 0.549\*\*\* |
| **3. Occupational variables** | |
| Farming experience (in years) | 0.230 |
| Occupation other than farming | -0.228 |
| Type of labour | 0.065 |
| Gender of labour | -0.010 |
| **4. Information Access and Utilization variables** | |
| Mass media exposure | 0.686\*\*\* |
| Information source utilization | 0.452\*\* |

\*\*\* Correlation is significant at 0.001 level (two tailed)

\*\* Correlation is significant at 0.01 level (two tailed)

\* Correlation is significant at 0.05 level (two tailed)

Annual income (r = 0.475) emerged as another significant variable, highlighting the foundational role of financial security in shaping livelihood outcomes. A stable and adequate income enables women to invest in education, health, and farm improvements, while also providing a cushion against economic shocks.

Information source utilization (r = 0.452) and extension contact (r = 0.447) were also significantly associated with livelihood security. These findings point to the importance of timely and reliable knowledge flow from formal institutions to women at the grassroots. Access to agricultural advisories, scheme-related information, and technical support equips women to adopt better practices and access entitlements, thereby improving livelihood resilience. Studies by Adebayo and Worth (2022) have similarly emphasized that gender-responsive extension services lead to greater awareness and adoption of recommended practices among women farmers.

Educational qualification (r = 0.414) showed a significant and positive relationship, affirming that education plays a pivotal role in enabling women to access services, manage resources effectively, and participate in institutional platforms. Women with higher levels of education are more confident in interacting with service providers and more capable of interpreting information, which directly impacts their livelihood decisions.

Land holdings (r = 0.226) and farming experience (r = 0.230), though not statistically significant, showed weak but positive correlations, suggesting that greater control over land and longer years of experience contribute marginally to livelihood security. However, the impact of these factors appears to be less direct, especially in the plantation-based agricultural setting of Idukki, where land ownership may not always translate into increased agency or access to institutional support. Ownership of land (r = 0.198) similarly showed a low correlation, reinforcing previous observations that structural factors, such as gender-biased inheritance and lack of documentation, often restrict women’s capacity to benefit fully from land assets (Agarwal, 2003).

Variables such as age (r = 0.003), marital status (r = 0.005), and type of family (r = 0.106) did not demonstrate meaningful associations with livelihood security. This suggests that demographic background alone does not significantly influence the livelihood status of women in Idukki, unless mediated by access to social or economic capital. The weak negative correlation observed with occupation other than farming (r = –0.228) indicates that women engaged in casual non-farm employment may face irregular income, lesser security, and fewer entitlements, which could lower their overall livelihood strength.

Other variables like percentage of income from agriculture (r = 0.128), possession of implements (r = 0.051), type of labour (r = 0.065), and gender of labour (r = –0.010) showed weak or no correlation with livelihood security. These findings suggest that while such variables may affect operational efficiency, they do not independently determine the livelihood status of women in the study area.

**Table 4. Ranking of challenges faced by women farmers based on garret ranking technique**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No** | **Constraints** | **Mean Garret Score** | **Rank** |
| 1 | Limited ownership and control over agricultural land | 72.85 | I |
| 2 | Lack of decision-making power within household and community | 70.40 | II |
| 3 | Physical strain due to difficult terrain and climatic conditions | 68.65 | III |
| 4 | Psychological stress due to multitasking and social expectations | 66.20 | IV |
| 5 | Poor market access and price fluctuation for farm produce | 64.55 | V |
| 6 | Inadequate availability of skilled labour | 60.10 | VI |
| 7 | Lack of gender-sensitive extension services | 58.25 | VI |
| 8 | Poor access to timely and location-specific technical information | 55.70 | VII |
| 9 | Limited access to institutional credit and subsidies | 53.85 | VIII |
| 10 | Low participation in agricultural training and capacity-building programmes | 51.40 | X |

The results of the Garrett ranking analysis (Table 4) revealed a complex interplay of structural, social, and institutional challenges that continue to affect the livelihood security of women farmers in the high-range region of Idukki, despite Kerala’s reputation as one of India’s most gender-progressive states. While it is true that Kerala has made significant advancements in women’s literacy, health, and social development, and even reports higher levels of female landownership compared to other Indian states (Agarwal, 2023), the situation on the ground, particularly in remote and ecologically challenging areas like Idukki, presents a more nuanced reality.

Among the various challenges assessed, limited ownership and control over agricultural land emerged as the most severe one. This may appear contradictory in a state like Kerala, where land reform movements historically contributed to more equitable land distribution. However, studies have shown that legal ownership does not always translate into actual control or decision-making authority over land use (Agarwal, 2020). In many cases, titles may be jointly held or inherited by women, but major agricultural decisions are still made by male family members. This gap between legal entitlement and functional empowerment restricts women’s access to institutional benefits such as loans, subsidies, and formal recognition as cultivators.

Closely following was the lack of decision-making power within households and community structures. Despite being actively involved in farming, women in Idukki often find themselves excluded from formal discussions on crop planning, investment, and marketing. Innazent and Krishna (2022) observed that in many panchayats of Kerala, women’s participation in decision-making tends to be consultative rather than decisive, reflecting persistent gender norms even in otherwise inclusive local governance systems.

Physical strain due to the hilly terrain and challenging climatic conditions was another major concern. Farming in the high ranges requires long hours of manual labour, particularly in terraced fields and rain-fed slopes that are less amenable to mechanization. This physical hardship is compounded by the psychological burden women face in balancing multiple responsibilities across agriculture, household duties, and caregiving roles. Gupta (2025) highlights that such multitasking leads to chronic stress and fatigue, which ultimately impacts both productivity and well-being.

Other challenges include market instability, as women in remote areas struggle with low bargaining power and irregular access to cooperative networks; skilled labour shortages, which exacerbate manual drudgery; and gender-insensitive extension services and poor access to tailored technical information, both of which hinder adoption of improved practices.

So, these findings point to a layered reality where Kerala’s commendable progress in gender development coexists with deep-rooted barriers that still constrain the full agricultural potential of women, especially in ecologically fragile and socially complex areas like Idukki. Bridging this gap requires policies and interventions that go beyond statistical progress and focus on empowering women at the functional, basic level through land rights enforcement, gender-sensitive credit mechanisms, context-specific extension, and inclusive training frameworks that acknowledge their lived realities.

4. Conclusion

The present study examined the livelihood security of women farmers in the high-altitude agricultural context of Idukki district, Kerala. The findings revealed that a majority of the women farmers surveyed experienced low to moderate levels of livelihood security, reflecting persistent vulnerabilities in areas such as income generation, access to services, and social inclusion. The plantation and spice-based farming system of Idukki, while offering commercial potential, is shaped by volatile markets, limited institutional outreach, and gendered inequalities in access to land and decision-making spaces. Further analysis through Spearman rank correlation established that livelihood security is strongly influenced by factors such as mass media exposure, social participation, annual income, educational attainment, and access to information and extension services. These findings underscore the need for tailored interventions that go beyond asset provision and address the enabling conditions for women’s livelihood particularly in remote and geographically challenging regions.

Strengthening rural communication networks, enhancing participation in community institutions, and promoting inclusive extension systems are essential steps toward ensuring more secure and resilient livelihoods for women farmers in Idukki. By integrating gender considerations into development planning and targeting structural barriers, the path towards sustainable and equitable rural development can be made more accessible to women who remain at the margins of mainstream agricultural discourse.

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**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

**AUTHORS CONTRIBUTIONS**

Author 1 designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author 2 guided, read and approved the final manuscript.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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