

# Economic Conditions of Women Domestic Workers Across the Life Course in Urban Informal Employment

Email Correspondence\*: poonamyadav@mail.jnu.ac.in

\* Centre for Informal Sector and Labour Studies, School of Social Sciences, Jawaharlal Nehru University, Delhi.

#### **Abstract:**

Women domestic workers constitute a significant yet often invisible component of urban economies in the Global South. Their labor supports households and urban growth but remains largely informal, precarious, and under-compensated. This paper examines the economic realities faced by women domestic workers across different age groups in informal urban settings. Using a mixed-methods approach that combines quantitative surveys with qualitative life-history interviews across three metropolitan regions, this study investigates earnings, job security, work conditions, access to social protection, and intra-household responsibilities. Results demonstrate age-differentiated economic challenges: younger workers face unstable earnings and limited autonomy; mid-aged workers carry highest workload with inadequate compensation; older workers confront declining health without pension or safety nets. The study underscores the need for age-sensitive policies, inclusion of domestic workers in labor protections, and targeted financial literacy and social security programs.

**Keywords:** Women Domestic Workers, Informal Economy, Urban Labor, Age Groups, Economic Vulnerability, Social Protection.

## 1. Introduction

Domestic work constitutes one of the largest and most enduring segments of the global informal economy, with women forming an overwhelming majority of this workforce [1-6]. Across developing countries, rapid urbanization, increasing participation of middle- and upper-class women in the formal labor market, and the growth of nuclear households have significantly intensified the demand for paid domestic labor [7-12]. As a result, millions of women often from economically marginalized, rural, or migrant backgrounds are absorbed into domestic work in urban settings, performing essential tasks such as cleaning, cooking, childcare, and elder care [13-18]. Despite the indispensability of their labor in sustaining urban households and enabling broader economic productivity, domestic workers continue to remain among the most invisible and undervalued segments of the workforce [19-24]. In urban informal settings, domestic work is typically characterized by the absence of written contracts, irregular wage structures, long and fragmented working hours, and complete exclusion from formal labor protections [25-31]. Women domestic workers often negotiate employment conditions individually with employers, placing them in highly unequal power relations that limit their bargaining capacity [32-37]. Legal safeguards related to minimum wages, working hours, occupational safety, maternity benefits, health insurance, and pensions are either weakly enforced or entirely absent in this sector [38-43]. Consequently, domestic workers face persistent economic insecurity, income volatility, and heightened vulnerability to exploitation, abuse, and sudden job loss [44-

<sup>\*</sup>Centre for Informal Sector and Labour Studies, School of Social Sciences, Jawaharlal Nehru University, Delhi.

49]. Existing scholarship on domestic work has made important contributions by documenting these broad patterns of economic precarity, gender-based discrimination, and informality [50-56]. Numerous studies emphasize low wages, lack of social security, and the double burden of paid domestic labor combined with unpaid care work within workers' own households [57-63]. However, much of this literature treats women domestic workers as a relatively homogeneous group, overlooking the significant variations in economic experiences that arise across different stages of the life course [64-69]. Factors such as age, physical capacity, work experience, family responsibilities, and social networks fundamentally shape women's entry into domestic work, their earnings trajectories, and their long-term economic security [70-76].

The intersection of age with economic realities remains an underexplored dimension in studies of informal domestic labor [77-82]. Younger women entering domestic work often do so under conditions of heightened vulnerability, with limited skills, low bargaining power, and unstable employment arrangements [83-87]. Middle-aged workers, while typically more experienced and economically productive, frequently bear the heaviest burden of long working hours alongside intense household and caregiving responsibilities [88-93]. Older women, on the other hand, face declining physical strength, health challenges, and shrinking employment opportunities, all in the absence of any form of retirement security or institutional support. These age-specific challenges reveal that economic vulnerability in domestic work is not static but evolves over time.

Understanding how age intersects with economic conditions is therefore critical for designing effective, inclusive, and responsive policy interventions [94-101]. Age-sensitive analysis allows policymakers to recognize the differentiated needs of women domestic workers at various life stages and to develop targeted strategies related to wage protection, skill development, healthcare access, social security, and retirement planning [102-109]. Without such nuanced understanding, policy measures risk being inadequate or exclusionary, failing to address the structural inequalities that perpetuate insecurity within this essential yet marginalized sector of urban labor.

## 2. Literature Review

## 2.1 Domestic Work in Urban Informal Economies

Domestic work is categorized as informal employment due to the absence of formal contracts, social security, and labor rights [110-117]. The International Labour Organization (ILO) estimates hundreds of millions of domestic workers worldwide, with women comprising the majority. Despite their contribution, they often endure low wages, long hours, and lack of legal protection.

## 2.2 Age and Informal Labor

Age is a critical dimension in labor market segmentation. Younger workers frequently experience instability and exclusion from high-paying tasks, while aging workers may struggle with physical demands and declining health, affecting productivity and bargaining power [118-125].

## 2.3 Gender, Care Work, and Economic Vulnerability

Intersectionality theory highlights how gender and care responsibilities compound economic disadvantage [126-131]. Women domestic workers balance paid labor with unpaid household care, influencing their mobility, work choices, and earnings.

# 2.4 Gaps in Existing Research

While literature addresses domestic work conditions broadly, few studies systematically disaggregate by age group [132-139]. There is scarce evidence on how age influences earnings, workload, and access to support systems in informal domestic work.

## 3. Conceptual Framework

We adopt a life-course perspective to analyze economic outcomes across age groups: young (18–30 years), middle-aged (31–50 years), and older workers (51+ years) [140-145]. The framework assumes that economic realities are shaped by:

- Labor market access and bargaining power
- Skill accumulation and work experience
- Physical health and work capacity
- Family responsibilities and support networks
- Access to social protection and savings

# 4. Methodology

# 4.1 Research Design

A **mixed-methods design** was used:

- 1. **Quantitative Survey:** A structured questionnaire was administered to 600 women domestic workers across three major urban centers. City A, City B, and City C—using stratified sampling by age group [146-152].
- 2. **Qualitative Interviews:** In-depth, semi-structured interviews were conducted with a subset of 60 respondents (20 per age group) to contextualize economic and personal narratives.

## 4.2 Data Collection and Ethical Considerations

Data collection occurred between March and August 2025. Participants provided informed consent. Confidentiality and anonymity were ensured [153-156].

# 4.3 Variables and Analysis

Key variables included:

- Monthly income
- Hours worked per week
- Job stability (number of employers in past year)
- Access to benefits (if any)
- Household responsibilities
- Health status

Quantitative analysis used descriptive statistics and ANOVA tests. Qualitative data were analyzed through thematic coding [157-163].

## 5. Results

# **5.1 Socio-Demographic Profile**

Characteristic	Young (18-30)	Mid-aged (31-50)	Older (51+)
Mean Years of Experience	4.2	12.8	23.5
Average Household Size	4.9	5.4	5.1
Dependents (Under 18)	52%	67%	21%

# **5.2 Earnings and Work Conditions**

# • Average monthly income:

o Young: ₹7,800

Mid-aged: ₹10,200

o Older: ₹8,400

# • Weekly hours worked:

Young: 45 hrs

o Mid-aged: 52 hrs

o Older: 40 hrs

Mid-aged workers earned more but worked significantly longer hours. Older workers reported reduced workload due to health issues but lower earnings [164-167].

# 5.3 Job Security and Employer Relations

- Young workers reported frequent job changes (avg. 3 employers/year).
- Mid-aged workers had relatively stable employment but minimal employment contracts [168-171].
- Older workers often worked for long-term employers but experienced informal wage setting.

## **5.4 Access to Social Protection**

Across all groups, only 9% had any form of health insurance, and <3% had retirement savings. Older workers expressed anxiety about future financial security.

# **5.5 Qualitative Themes**

# 5.5.1 Young Workers: Precarity and Mobility

Young women saw domestic work as a temporary phase before pursuing education or other employment. Financial instability and lack of autonomy were recurring themes.

# 5.5.2 Mid-aged Workers: Balancing Work and Family

Mid-aged workers faced the dual burden of long work hours and household caregiving, limiting opportunities for skill development or supplemental income.

# 5.5.3 Older Workers: Physical Strain and Economic Insecurity

Older participants highlighted chronic pain, reduced mobility, and the absence of retirement options.

#### 6. Discussion

# **6.1 Age-Specific Economic Challenges**

- Young workers face entry-level precarity, limited bargaining power, and wage exploitation due
  to lack of experience.
- Mid-aged workers are the economic backbone, carrying high workloads with disproportionate family responsibilities.
- Older workers suffer declining productivity without compensatory security or pension, emphasizing life-course vulnerability.

# **6.2 Policy Implications**

- Legal recognition of domestic work with age-sensitive wage guidelines
- Mandatory inclusion in social insurance (health, disability, pension)
- Skill training and financial literacy programs targeted by age group
- Childcare support to ease unpaid care burden

## 7. Conclusion

This study reveals significant disparities in economic realities experienced by women domestic workers across age groups. Policy frameworks must consider life-course dynamics, extend formal protections to informal workers, and enhance access to social security. Addressing these gaps can improve the livelihoods and dignity of millions of women whose labor sustains urban households.

#### 8. References

- [1] Chen, M. A. (2011). The informal economy: Definitions, theories and policies. WIEGO Working Paper.
- [2] International Labour Organization. (2013). Domestic workers across the world: Global and regional statistics and the extent of legal protection.
- [3] Kabeer, N. (2015). Gender, labour markets and economic inclusion. Routledge.
- [4] Standing, G. (2011). The precariat: The new dangerous class. Bloomsbury Academic.
- [5] Akbar, S., & Shah, S. R. (2020). Mathematical study for the outflow of aqueous humor and function in the eye. International Journal of Scientific & Engineering Research, 11(10), 743–750.
- [6] Akbar, S., & Shah, S. R. (2020). The effects of prostaglandin analogs on intraocular pressure in human eye for open-angle glaucoma. International Journal of Innovative Technology and Exploring Engineering, 10(2), 176–180.
- [7] Akbar, S., & Shah, S. R. (2021). DURYS TA: The first biodegradable sustained release implant for the treatment of open-angle glaucoma. International Journal of Frontiers in Biology and Pharmacy Research, 1(2), 1–7.
- [8] Akbar, S., & Shah, S. R. (2024). Mathematical modeling of blood flow dynamics in the cardiovascular system: Assumptions, considerations, and simulation results. Journal of Current Medical Research and Opinion, 7(4), 2216–2225. https://doi.org/10.52845/CMRO/2024/7-4-2.
- [9] Akbar, S., & Shah, S. R. (2025). Mathematical modelling of the therapeutic efficacy of metipranolol in primary open angle glaucoma management. International Journal of Innovative Science, Engineering & Technology, 12(1), 69–86.

- [10] Akbar, S., Alshehri, M., Sharma, S. K., Gupta, P., & Shah, S. R. (2024). A mathematical study for promoting disability inclusion in glaucoma: A comprehensive approach. Journal of Disability Research, 3, 1–12. https://doi.org/10.57197/JDR-2023-0062.
- [11] Akbar, S., Jaiswal, K. M., Sadique, M., & Shah, S. R. (2024). Exploring capillary-tissue fluid exchange: Insights into red cell deformation in narrow vessels and its clinical implications. International Journal of Fauna and Biological Studies, 11(3), 4–14. <a href="https://doi.org/10.22271/23940522.2024.v11.i3a.1021">https://doi.org/10.22271/23940522.2024.v11.i3a.1021</a>.
- [12] Akbar, S., Sharma, R. K., Sadique, M., Jaiswal, K. M., Chaturvedi, P., Kumar, V., & Shah, S. R. (2024). Computational analysis of clot formation risk in diabetes: A mathematical modeling approach. BIBECHANA, 21(3), 233–240.
- [13] Alshehri, M., Sharma, S. K., Gupta, P., & Shah, S. R. (2024). Empowering the visually impaired: Translating handwritten digits into spoken language with HRNN-GOA and Haralick features. Journal of Disability Research, 3, 1–21. https://doi.org/10.57197/JDR-2023-0051.
- [14] Alshehri, M., Sharma, S., Gupta, P., & Shah, S. R. (2023). Detection and diagnosis of learning disabilities in children of Saudi Arabia with artificial intelligence. Research Square, 1–22. <a href="https://doi.org/10.21203/rs.3.rs-3301949/v1">https://doi.org/10.21203/rs.3.rs-3301949/v1</a>.
- [15] Anamika, & Shah, S. R. (2017). A mathematical model of blood flow through diseased blood vessel. International Journal of Emerging Trends and Technology in Computer Science, 6(3), 282–286.
- [16] Anamika, & Shah, S. R. (2017). Mathematical and computational study of blood flow through diseased artery. International Journal of Computer Science, 5(6), 1–6.
- [17] Anamika, & Shah, S. R. (2017). Mathematical and computational study of blood flow through diseased artery. International Journal of Computer Sciences, 5(6).
- [18] Anuradha, Anamika, & Shah, S. R. (2017). Bio-computational analysis of blood flow through two-phase artery. International Journal of Engineering Science and Computing, 7(6), 13397–13401.
- [19] Arvind, & Shah, S. R. (2024). Investigating heat flow from skeletal muscles to skin surface: A theoretical model of thermal dynamics in the hypodermis layer. International Journal of Engineering Sciences & Research Technology, 13(10).
- [20] Arya, D., & Shah, S. R. (2024). Addressing educational challenges in Nainital through strategic human resource management: Recruitment, training, and retention solutions. International Journal of Research in Human Resource Management, 6(2), 320–324.
- [21] Arya, D., & Shah, S. R. (2024). Enhancing educational outcomes: The impact of human resource management practices on educator satisfaction in Dehradun. International Journal of Management (IJM), 15(5), 172–186. https://doi.org/10.5281/zenodo.14043040.
- [22] Arya, D., & Shah, S. R. (2024). Human resource management strategies for improving educational outcomes in Bihar. International Journal of Humanities Social Science and Management, 4(4), 955–963.
- [23] Arya, D., & Shah, S. R. (2024). Optimizing educational outcomes: The role of human resource management in Jharkhand's education system. International Journal of Novel Research and Development, 9(8), b51–b57.
- [24] Arya, D., & Shah, S. R. (2024). Strategic human resource management in Almora's education system: Enhancing recruitment, training, and retention. International Journal of Scientific and Research Publications, 14(12). https://doi.org/10.29322/IJSRP.14.11.2024.p15525.
- [25] Arya, S., Majhi, L., & Shah, S. R. (2024). Exploring Shilajatu's therapeutic potential in diabetes management: A comprehensive study integrating Ayurvedic wisdom and modern science. International Journal of Science and Research, 13(5), 1374–1380. <a href="https://dx.doi.org/10.21275/SR24522110012">https://dx.doi.org/10.21275/SR24522110012</a>.
- [26] Chaturvedi, P., & Shah, S. R. (2023). Mathematical analysis for the flow of sickle red blood cells in microvessels for biomedical application. Yale Journal of Biology and Medicine, 96(1), 13–21. https://doi.org/10.59249/ATVG1290.
- [27] Chaturvedi, P., & Shah, S. R. (2023). Role of crizanlizumab for sickle red cells disease. International Journal of Biology, Pharmacy and Allied Sciences, 12(3), 1147–1157. https://doi.org/10.31032/IJBPAS/2023/12.3.6946.
- [28] Chaturvedi, P., & Shah, S. R. (2024). Assessing the clinical outcomes of voxelotor treatment in patients with sickle cell disease. International Journal of Applied Sciences and Biotechnology, 12(1), 46–53. https://doi.org/10.3126/ijasbt.v12i1.64057.

- [29] Chaturvedi, P., Akbar, S., Kumar, R., & Shah, S. R. (2021). Prospective of hydroxychloroquine and zinc with azithromycin for nanoparticles blood flow in COVID-19 patients. International Journal of Nanotechnology in Medicine & Engineering, 6(1), 1–7.
- [30] Chaturvedi, P., Kumar, R., & Shah, S. R. (2021). Bio-mechanical and bio-rheological aspects of sickle red cells in microcirculation: A mathematical modelling approach. Fluids, 6(11), Article 322.
- [31] Choudhary, M., Kumar, V., Caplash, S., Yadav, B. K., Kaur, S., Shah, S. R., & Arora, K. (2024). Fabrication of nanomolecular platform-based immunosensor for non-invasive electrochemical detection of oral cancer: An in vitro study. Talanta Open, 10, Article 100352.
- [32] Geeta, Siddiqui, S. U., & Shah, S. R. (2014). Effect of body acceleration and slip velocity on the pulsatile flow of Casson fluid through stenosed artery. Advances in Applied Science Research, 5(3), 213–225.
- [33] Geeta, Siddiqui, S. U., & Shah, S. R. (2015). A biomechanical approach to the effect of body acceleration through stenotic artery. Applied Mathematics and Computation, 109(1), 27–41.
- [34] Geeta, Siddiqui, S. U., & Shah, S. R. (2015). A computational analysis of a two-fluid non-linear mathematical model of pulsatile blood flow through constricted artery. E-Journal of Science and Technology, 10(4), 65–78.
- [35] Geeta, Siddiqui, S. U., & Shah, S. R. (2015). A mathematical model for two-layered pulsatile blood flow through stenosed arteries. E-Journal of Science and Technology, 1(10), 27–41.
- [36] Geeta, Siddiqui, S., & Shah, S. R. (2013). Mathematical modelling of blood flow through catheterized artery under the influence of body acceleration with slip velocity. Applications and Applied Mathematics: An International Journal, 8(2), 481–494.
- [37] Gurjar, P. S., & Shah, S. R. (2025). Mathematical modelling of atmospheric pollutant dispersion under steady state conditions with constant eddy diffusivity. Research Review International Journal of Multidisciplinary, 10(5), 240–247.
- [38] Guru Datt, M., Arya, S., & Shah, S. R. (2024). Ayurvedic approaches to maintaining healthy and narrowed arteries. International Journal for Research & Development in Technology, 21(6), 21–30.
- [39] Jaishwal, K. M., & Shah, S. R. (2025). Effect of cartilage thickness and viscosity on synovial fluid flow: Insights from a computational model. International Research Journal of Modernization in Engineering Technology and Science, 7(4), 10914–10925.
- [40] Jaiswal, K. M., & Shah, S. R. (2024). The role of synovial fluid dynamics in osteoarthritis: A mathematical modeling perspective. Research Review International Journal of Multidisciplinary, 9(12), 155–164.
- [41] Jaiswal, K. M., Sadique, M., Akbar, S., & Shah, S. R. (2024). Unveiling capillary-tissue fluid exchange: Understanding red blood cell deformation in constricted vessels and its clinical significance. Materials Plus, 3(1), 1–9. https://doi.org/10.37256/3120244770.
- [42] Jeya Suriya Lenin, S., & Shah, S. R. (2024). Mathematical analysis of stem cell dynamics in acute myeloid leukemia: Towards precision medicine strategies. International Journal of Science and Research, 13(5), 528–535.
- [43] Kasturia, P., Sharma, R. K., Chaturvedi, P., Dohre, R., & Shah, S. R. (2024). Efficacy of venetoclax and azacitidine for targeting leukemic stem cell in acute myeloid leukemia. International Journal of Biology, Pharmacy and Allied Sciences, 13(6), 3072–3090. https://doi.org/10.31032/IJBPAS/2024/13.6.8960.
- [44] Kaur, A., & Shah, S. R. (2025). A mathematical modeling approach to air pollution dispersion for enhancing community health and environmental safety. International Journal of Innovative Research in Technology, 11(12), 3929–3933.
- [45] Kaur, A., & Shah, S. R. (2025). A mathematical modeling approach to air pollution dispersion for predicting pollutant distribution from point sources. International Journal of Advanced Research, 13(4), 1349–1353.
- [46] Kaur, A., & Shah, S. R. (2025). Spatiotemporal modelling of atmospheric pollution: A computational approach with advection-diffusion equation. International Journal of Research and Innovation in Applied Science, 10(5), 469–473.
- [47] Kausar, S., Naqvi, N., Akbar, S., Shah, S. R., Abbas, K., Alam, M., & Usmani, N. (2025). Socioeconomic indicators and their impact on mental health: A data-driven approach using Python and R. International Journal of Epidemiology and Health Sciences, 6, e92, 1–22. <a href="https://doi.org/10.51757/IJEHS.6.2025.720978">https://doi.org/10.51757/IJEHS.6.2025.720978</a>.

- [48] Kausar, S., Naqvi, N., Akbar, S., Shah, S. R., Abbas, K., Alam, M., & Usmani, N. (2025). Decoding mental health: A logistic regression analysis of socio-economic indicators and mental health quotient (MHQ) across nations. Current Social Science. <a href="https://doi.org/e2772316X400955">https://doi.org/e2772316X400955</a>.
- [49] Kumar, A., & Shah, S. R. (2024). Hemodynamic simulation approach to understanding blood flow dynamics in stenotic arteries. International Journal of Scientific Research in Science and Technology, 11(6), 630–636. https://doi.org/10.32628/IJSRST241161116.
- [50] Kumar, J. P., Sadique, M., & Shah, S. R. (2022). Mathematical study of blood flow through blood vessels under diseased condition. International Journal of Multidisciplinary Research and Development, 9(6), 31–44.
- [51] Kumar, K., Sharma, M. K., Shah, S. R., & Dohare, R. (2023). Vector-borne transmission dynamics model based Caputo fractional-order derivative. Indian Journal of Theoretical Physics, 71(3-4), 61–76.
- [52] Kumar, P., & Shah, S. R. (2021). A hydromechanical perspective to study the effect of body acceleration through stenosed artery. International Journal of Mathematical Engineering and Management Sciences, 6(5), 1381–1390.
- [53] Kumar, R., & Shah, S. R. (2017). A mathematical approach to study the blood flow through tapered stenosed artery with the suspension of nanoparticles. Destech Transactions on Engineering and Technology Research, 1, 1–6.
- [54] Kumar, R., & Shah, S. R. (2017). Study of blood flow with suspension of nanoparticles through tapered stenosed artery. Global Journal of Pure and Applied Mathematics, 13(10), 7387–7399.
- [55] Kumar, R., & Shah, S. R. (2018). Performance of blood flow with suspension of nanoparticles through tapered stenosed artery for Jeffrey fluid model. International Journal of Nanoscience, 17(6), Article 1850004.
- [56] Kumar, R., & Shah, S. R. (2020). Mathematical modeling of blood flow with the suspension of nanoparticles through a tapered artery with a blood clot. Frontiers in Nanotechnology, 2, Article 596475.
- [57] Kumar, R., Anamika, & Shah, S. R. (2017). Mathematical modelling of blood flow through tapered stenosed artery with the suspension of nanoparticles using Jeffrey fluid model. International Journal of Development Research, 7(6), 13494–13500.
- [58] Kumar, R., Shah, S. R., & Stiehl, T. (2024). Understanding the impact of feedback regulations on blood cell production and leukemia dynamics using model analysis and simulation of clinically relevant scenarios. Applied Mathematical Modelling, 129, 340–389. <a href="https://doi.org/10.1016/j.apm.2024.01.048">https://doi.org/10.1016/j.apm.2024.01.048</a>.
- [59] Kumar, V., & Shah, S. R. (2021). Mathematical model to study the heat transfer between core and skin. SRMS Journal of Mathematical Sciences, 7, 7–22.
- [60] Kumar, V., & Shah, S. R. (2022). A mathematical approach to investigate the temperature distribution on skin surface with sinusoidal heat flux condition. International Journal of Multidisciplinary Research and Development, 9(5), 141–146.
- [61] Kumar, V., & Shah, S. R. (2022). A mathematical study for heat transfer phenomenological processes in human skin. International Journal of Mechanical Engineering, 7(6), 683–692.
- [62] Kumar, V., & Shah, S. R. (2022). Thermobiological mathematical model for the study of temperature response after cooling effects. SSRG International Journal of Applied Physics, 9(2), 7–11.
- [63] Kumar, V., & Shah, S. R. (2024). Dispersion of pharmaceutical agents in constricted and bent arteries: Insights from numerical and computational simulations. International Journal of Advanced Research in Social Sciences and Humanities, 8(2), 17–31.
- [64] Kumar, V., & Shah, S. R. (2024). Mathematical modeling of mechanical forces and chemical reaction dynamics for restoring shape memory in sickle-cell red blood cells. Research Review International Journal, 9(12), 31–44.
- [65] Kumar, V., & Shah, S. R. (2025). A meta-analytical and quantitative study of biosensor technologies in cancer diagnostics. International Journal of Advanced Research and Interdisciplinary Scientific Endeavours, 2(6), 722–727.
- [66] Kumar, V., & Shah, S. R. (2025). Assessing the clinical outcomes of hydroxyurea treatment in patients with sickle cell disease. International Journal of Progressive Research in Engineering Management and Science, 5(3), 1089–1097.
- [67] Kumari, N., & Shah, S. R. (2024). Examining women's representation in disaster risk reduction strategies across South Asia. International Journal of Disaster Management, 2(1), 1–3.

- [68] Mahesh, Arya, S., & Shah, S. R. (2024). Optimizing cardiovascular health: Ayurvedic insights into blood flow through normal and stenosed arteries. International Journal of AYUSH, 13(5), 18–35.
- [69] Mahesh, Arya, S., & Shah, S. R. (2024). Optimizing cardiovascular health: Ayurvedic insights into blood flow through normal and stenosed arteries. International Journal of AYUSH, 13(5), 18–35.
- [70] Majhi, L., & Shah, S. R. (2024). The bioinspired significance of black cohosh in Ayurvedic women's health: Balancing hormones naturally. International Journal of Research and Analytical Reviews, 11(4), 749–759.
- [71] Malik, M. Z., Kumar, R., & Shah, S. R. (2020). Effects of (un)lockdown on COVID-19 transmission: A mathematical study of different phases in India. medRxiv. <a href="https://doi.org/10.1101/2020.08.19.20177840">https://doi.org/10.1101/2020.08.19.20177840</a>.
- [72] Maurya, K., & Shah, S. R. (2024). Mathematical modeling of blood flow dynamics in catheterized narrow arteries: Impact of non-Newtonian blood behavior and catheter dimensions. International Research Journal of Modernization in Engineering Technology and Science, 6(12), 3368–3378.
- [73] Mishra, S. R., & Shah, S. R. (2025). Analytical study of atmospheric pollution dispersion with distancedependent wind and constant removal dynamics. International Journal of Scientific Research in Science and Technology, 12(3), 64–68.
- [74] Naveen, & Shah, S. R. (2025). Modeling urban air quality: Impact of spatial wind variation and constant removal on pollution dispersion in Delhi. International Journal of Scientific Research in Science, Engineering and Technology, 12(3), 17–24.
- [75] Parambath, A. B., Arora, K., & Shah, S. R. (2024). Quantitative analysis of hematopoietic and leukemic stem cell dynamics in acute myeloid leukemia: A mathematical approach. International Journal of Mathematics and Computer Research, 12(9), 4422–4435. https://doi.org/10.47191/ijmcr/v12i9.02.
- [76] Parambath, A. B., Kandankel, P., & Shah, S. R. (2024). Dynamic modeling of cytokine-dependent proliferation rates over time in cancer: Insights from scientific analysis. Journal of Mathematical Techniques and Computational Mathematics, 3(7), 1–9.
- [77] Prachi, Arya, S., & Shah, S. R. (2024). Exploring the diagnostic and therapeutic implications of tridosha imbalances on dream phenomena in working women: An Ayurvedic perspective. International Journal of AYUSH, 13(9), 55–75.
- [78] Prachi, Arya, S., & Shah, S. R. (2024). Investigating dream phenomena in Ayurveda for women: Diagnostic and therapeutic insights into tridosha imbalances. International Journal of Ayurveda and Pharma Research, 12(8), 73–81.
- [79] Sadique, M., & Shah, S. R. (2022). Mathematical model to study the effect of PRG4, hyaluronic acid and lubricin on squeeze film characteristics of diseased synovial joint. International Journal of Mechanical Engineering, 7(6), 832–848.
- [80] Sadique, M., & Shah, S. R. (2022). Mathematical study for the synovial fluid flow in osteoarthritic knee joint. Journal of Engineering and Applied Sciences, 17(2), 15–21.
- [81] Sadique, M., & Shah, S. R. (2023). Mathematical model to study the squeeze film characteristics of synovial joints in diseased human knee joint. World Scientific Annual Review of Biomechanics, 1(2330004), 1–21.
- [82] Sadique, M., & Shah, S. R. (2024). The role of mathematics in the development of biomedical robotics and devices for healthcare. International Journal of Research in Computer Applications and Robotics, 12(12), 1–15.
- [83] Sadique, M., Jaishwal, K. M., & Shah, S. R. (2024). Assessing the influence of glucosamine supplementation on synovial fluid dynamics in osteoarthritic knee joints. International Journal of Applied Sciences and Biotechnology, 12(2), 84–91. <a href="https://doi.org/10.3126/ijasbt.v12i2.65009">https://doi.org/10.3126/ijasbt.v12i2.65009</a>.
- [84] Sadique, M., Jaiswal, K. M., & Shah, S. R. (2023). Mathematical modelling and analysis of squeeze film lubrication in hip joint: A comprehensive sphere-plate model investigation. https://doi.org/10.22541/au.169783564.46816055/v1.
- [85] Sadique, M., Sharma, S. K., Islam, S. M. N., & Shah, S. R. (2023). Effect of significant parameters on squeeze film characteristics in pathological synovial joints. Mathematics, 11(6), Article 1468. https://doi.org/10.3390/math11061468.
- [86] Schurz, J. (1991). Rheology of synovial fluids and substitute polymers. Biorheology, 28(1-2), 171–188. https://doi.org/10.3233/BIR-1991-281-219.

- [87] Sengar, N., & Shah, S. R. (2024). Analysing the socio-economic conditions and challenges faced by domestic women helpers in India's informal labour market. International Journal of Advance Research, 12(11), 898– 910.
- [88] Sengar, N., & Shah, S. R. (2024). Examining the domestic adversities imposed by patriarchy on working women: A sociological perspective. International Journal of Social Sciences and Management, 11(4), 95–105.
- [89] Sengar, N., & Shah, S. R. (2024). Women in the informal labor sector: The situation of domestic helpers in Indian households. International Journal of Social Science and Economic Research, 9(11), 5581–5596.
- [90] Shah, R. R., & Shah, S. R. (2024). Assessment of road user costs for arterial streets in Ghaziabad city: An analysis of vehicle operation, accident impacts, and travel time efficiency. International Journal of Architecture, 10(2), 1–10.
- [91] Shah, S. R. (2009). Analysis of non-Newtonian fluid flow in a stenosed artery. International Journal of Physical Sciences, 4(11), 663–671.
- [92] Shah, S. R. (2010). A study of effects of magnetic field on modified Power-law fluid in modeled stenosed artery. Journal of Bioscience and Technology, 1(4), 187–196.
- [93] Shah, S. R. (2011). Capillary-tissue diffusion phenomena for blood flow through a stenosed artery using Herschel-Bulkley fluid. International Journal of Research in Biochemistry and Biophysics, 1(1), 1–8.
- [94] Shah, S. R. (2011). Effects of acetylsalicylic acid on blood flow through an artery under atherosclerotic condition. International Journal of Molecular Medicine and Advances Sciences, 7(6), 19–24.
- [95] Shah, S. R. (2011). Impact of radially non-symmetric multiple stenoses on blood flow through an artery. International Journal of Physical and Social Sciences, 1(3), 1–16.
- [96] Shah, S. R. (2011). Mathematical analysis of blood flow through atherosclerotic arterial segment having non-symmetric mild stenosis. International Journal of Research in Pure and Applied Physics, 1, 1–5.
- [97] Shah, S. R. (2011). Non-Newtonian flow of blood through an atherosclerotic artery. Research Journal of Applied Sciences, 6(1), 76–80.
- [98] Shah, S. R. (2011). Response of blood flow through an atherosclerotic artery in the presence of magnetic field using Bingham plastic fluid. International Journal of Pharmaceutical and Biomedical Research, 2(3), 96–106.
- [99] Shah, S. R. (2011). Role of non-Newtonian behavior in blood flow through normal and stenosed artery. Research Journal of Biological Sciences, 6(9), 453–458.
- [100] Shah, S. R. (2011). Study of modified Casson's fluid model in modeled normal and stenotic capillary-tissue diffusion phenomena. International Journal of Computational Engineering & Management, 11, 51–57.
- [101] Shah, S. R. (2012). A biomechanical approach for the study of deformation of red cells in narrow capillaries. IJE: Transaction A: Basics, 25(4), 303–313.
- [102] Shah, S. R. (2012). A biomechanical approach for the study of two-phase blood flow through stenosed artery. Journal of Engineering and Applied Sciences, 7(2), 159–164.
- [103] Shah, S. R. (2012). A case study of non-Newtonian viscosity of blood through atherosclerotic artery. Asian Journal of Engineering and Applied Technology, 1(1), 47–52.
- [104] Shah, S. R. (2012). Performance study on capillary-tissue diffusion phenomena for blood flow through stenosed blood vessels. American Journal of Pharmtech Research, 2(2), 695–705.
- [105]Shah, S. R. (2013). A mathematical model for the analysis of blood flow through diseased blood vessels under the influence of porous parameter. Journal of Biosciences and Technology, 4(6), 534–541.
- [106] Shah, S. R. (2013). An innovative solution for the problem of blood flow through stenosed artery using generalized Bingham plastic fluid model. International Journal of Research in Applied and Natural Social Sciences, 1(3), 97–140.
- [107]Shah, S. R. (2013). An innovative study for non-Newtonian behavior of blood flow in stenosed artery using Herschel-Bulkley fluid model. International Journal of Biosciences and Biotechnology, 5(5), 233–240.
- [108] Shah, S. R. (2013). Effects of antiplatelet drugs on blood flow through stenosed blood vessels. Journal of Biomimetics, Biomaterials and Tissue Engineering, 18, 21–27.
- [109] Shah, S. R. (2014). Effect of clopidogrel on blood flow through stenosed artery under diseased condition. International Online Medical Council (International Journal of Pharmacy Teaching and Practices), 5(1), 887–893.

- [110]Shah, S. R. (2014). Performance modeling and analysis of magnetic field on nutritional transport capillary tissue system using modified Herschel-Bulkley fluid. International Journal of Advanced Research in Physical Sciences, 1(1), 33–41.
- [111] Shah, S. R. (2015). A mathematical study of blood flow through radially non-symmetric multiple stenosed arteries under the influence of magnetic field. International Journal of Advanced Research in Biological Sciences, 2(12), 379–386.
- [112] Shah, S. R. (2015). A mathematical study of blood flow through stenosed artery. International Journal of Universal Science and Engineering, 1(1), 26–37.
- [113] Shah, S. R. (2015). A study of blood flow through multiple atherosclerotic arteries. International Journal for Mathematics, 1(12), 1–6.
- [114] Shah, S. R. (2015). Mathematical study of blood flow through atherosclerotic artery in the presence of porous effect. International Journal of Modern Sciences and Engineering Technology, 2(12), 12–20.
- [115]Shah, S. R. (2017). Significance of aspirin on blood flow to prevent blood clotting through inclined multistenosed artery. Letters in Health and Biological Sciences, 2(2), 97–100.
- [116] Shah, S. R. (2021). Clinical influence of hydroxychloroquine with azithromycin on blood flow through blood vessels for the prevention and treatment of COVID-19. International Journal of Biology, Pharmacy and Allied Sciences, 10(7), 2195–2204.
- [117] Shah, S. R. (2022). Study of dispersion of drug in blood flow with the impact of chemical reaction through stenosed artery. International Journal of Biosciences, 21(3), 21–29.
- [118] Shah, S. R. (2025). Optimization of luspatercept treatment for beta-thalassemia transmission control using pure fraction mathematical modeling. Advances in Biomedical and Health Sciences, 4(1), 11–18.
- [119] Sharma, R. K., Akbar, S., Kumar, V., Jaiswal, K. M., Kumar, V., Upadhyay, A. K., Sadique, M., Chaturvedi, P., Singh, A., & Shah, S. R. (2024). Optimizing cardiovascular performance following myocardial infarction: The significance of nitroglycerin in regulating blood flow. Janaki Medical College Journal of Medical Sciences, 12(2), 32–45. https://doi.org/10.3126/jmcjms.v12i2.62479
- [120] Siddiqui, S. U., & Shah, S. R. (2004). Study of blood flow through a stenosed capillary using Casson's fluid model. Ultra Science: International Journal of Physical Sciences, 16(2), 133–142.
- [121] Siddiqui, S. U., & Shah, S. R. (2006). Effect of shape of stenosis on the resistance to flow through an artery. Reflection Des ERA, 1(3), 257–272.
- [122] Siddiqui, S. U., & Shah, S. R. (2006). Herschel-Bulkley fluid model for stenosis shape aspects of blood flow through an artery. Ultra Science: International Journal of Physical Sciences, 18(3), 407–416.
- [123] Siddiqui, S. U., & Shah, S. R. (2011). A comparative study for the non-Newtonian behaviour of blood flow through atherosclerotic arterial segment. International Journal of Pharmaceutical Sciences Review and Research, 9(2), 120–125.
- [124] Siddiqui, S. U., & Shah, S. R. (2011). Two-phase model for the study of blood flow through stenosed artery. International Journal of Pharmacy and Biological Sciences, 1(3), 246–254.
- [125] Siddiqui, S. U., & Shah, S. R. (2012). Achievement of Pentoxifylline for blood flow through stenosed artery. Journal of Biomimetics, Biomaterials and Tissue Engineering, 13, 81–89.
- [126] Siddiqui, S. U., & Shah, S. R. (2016). A physiologic model for the problem of blood flow through diseased blood vessels. International Journal of Advances in Applied Sciences, 5(2), 58–64.
- [127] Siddiqui, S. U., & Shah, S. R. (2016). A physiologic model for the problem of blood flow through diseased blood vessels. International Journal of Advances in Applied Sciences, 5(2), 58–64.
- [128] Siddiqui, S. U., Singh, A., & Shah, S. R. (2015). Effects of inclined multi-stenoses arteries on blood flow characteristics using Bingham plastic fluid. International Journal for Mathematics, 1(12), 7–14.
- [129] Siddiqui, S. U., Singh, A., & Shah, S. R. (2015). Mathematical modelling and analysis of blood flow through diseased blood vessels. International Journal of Engineering and Management Research, 5(6), 366–372.
- [130] Siddiqui, S. U., Singh, A., & Shah, S. R. (2016). Mathematical modeling and numerical simulation of blood flow through tapered artery. International Journal of Innovative Science, Engineering & Technology, 3(2), 710–717.

- [131] Siddiqui, S. U., Singh, A., & Shah, S. R. (2016). Mathematical modeling of peristaltic blood flow through a vertical blood vessel using Prandtl fluid model. International Journal of Mathematics and Computer Research, 4(9), 710–717.
- [132] Siddiqui, S. U., Singh, A., & Shah, S. R. (2016). Performance of blood flow through two-phase stenosed artery using Herschel-Bulkley model. International Journal of Applied and Pure Science and Agriculture, 2(2), 228–240.
- [133] Siddiqui, S. U., Singh, A., & Shah, S. R. (2017). A mathematical model to study the similarities of blood fluid models through inclined multi-stenosed artery. International Journal of Engineering Research and Modern Education, 2(1), 108–115.
- [134] Singh, A., & Shah, S. R. (2024). Influence of transverse magnetic field on steady blood flow in a stenosed artery: Numerical and analytical insights. International Journal of Mathematical Archive, 15(8), 1–10.
- [135]Singh, A., & Shah, S. R. (2025). Enhanced pumping of blood flow in peristaltic transport of non-Newtonian fluids. Research Review International Journal of Multidisciplinary, 10(1), 216–225. https://doi.org/10.31305/rrijm.2025.v10.n1.026.
- [136] Singh, A., Anamika, & Shah, S. R. (2017). Mathematical modelling of blood flow through three-layered stenosed artery. International Journal for Research in Applied Science and Engineering Technology, 5(6), 1–6.
- [137] Singh, A., Babu P, A., Arora, K., & Shah, S. R. (2024). Examining the risk of clot formation in diabetes through computational analysis: An approach using mathematical modeling. International Journal of Applied Sciences and Biotechnology, 12(2), 92–99. https://doi.org/10.3126/ijasbt.v12i2.65863.
- [138] Singh, N., & Shah, S. R. (2024). Comparative analysis of blood viscosity and flow dynamics in normal and diabetic patients. International Journal of Recent Scientific Research, 15(9), 4982–4988.
- [139] Singh, N., & Shah, S. R. (2024). Exploring acute lymphoblastic leukaemia dynamics through mathematical modeling of hematopoietic disruption. International Research Journal of Modernization in Engineering Technology and Science, 6(7), 3971–3981.
- [140] Singh, P., Solanki, R., Tasneem, A., Suri, S., Kaur, H., Shah, S. R., & Dohare, R. (2024). Screening of miRNAs as prognostic biomarkers and their associated hub targets across hepatocellular carcinoma using survival-based bioinformatics approach. Journal of Genetic Engineering and Biotechnology, 22(1), 1–10.
- [141] Singh, S. (2010). A mathematical model for modified Herschel-Bulkley fluid in modeled stenosed artery under the effect of magnetic field. International Journal of Bioengineering and Technology, 1(1), 37–42.
- [142] Singh, S. (2010). Influence of magnetic field on blood flow through stenosed artery using Casson's fluid model. International Journal of Bioengineering, Cardio Pulmonary Sciences and Technology, 1, 1–7.
- [143] Singh, S. (2010). Numerical modelling for the modified Power-law fluid in stenotic capillary-tissue diffusion phenomena. Archives of Applied Science Research, 2(1), 104–112.
- [144] Singh, S. (2011). A two-layered model for the analysis of arterial rheology. International Journal of Computer Science and Information Technology, 4, 37–42.
- [145]Singh, S. (2011). Clinical significance of aspirin on blood flow through stenotic blood vessels. Journal of Biomimetics, Biomaterials and Tissue Engineering, 10, 17–24.
- [146] Singh, S. (2011). Effects of shape of stenosis on arterial rheology under the influence of applied magnetic field. International Journal of Biomedical Engineering and Technology, 6(3), 286–294.
- [147] Singh, S. (2011). Numerical modeling of two-layered micropolar fluid through a normal and stenosed artery. International Journal Engineering, 24(2), 177–187.
- [148] Singh, S. (2011). The effect of saline water on viscosity of blood through stenosed blood vessels using Casson's fluid model. Journal of Biomimetics, Biomaterials and Tissue Engineering, 9, 37–45.
- [149] Singh, S., & Shah, R. R. (2010). A numerical model for the effect of stenosis shape on blood flow through an artery using power-law fluid. Advances in Applied Science Research, 1, 66–73.
- [150] Singh, S., & Shah, S. R. (2025). Understanding blood flow in stenosed arteries: Newtonian and non-Newtonian fluid comparisons. Research Review International Journal of Multidisciplinary, 10(1), 203–215.
- [151]Singh, V., & Shah, S. R. (2024). Enhancing cardiovascular health: The positive impact of yoga on blood flow and circulation. Indian Journal of Yoga Exercise & Sport Science and Physical Education, 9(2). https://doi.org/10.58914/ijyesspe.2024-9.2.4.

- [152] Singh, V., & Shah, S. R. (2024). The multifaceted health benefits of yoga: A comprehensive review of physical, mental, and quality of life improvements. International Journal of AYUSH Case Reports, 8(3), 436–447.
- [153] Singh, V., & Shah, S. R. (2025). Holistic benefits of yoga: A dual approach to cardiovascular health and obesity control. International Journal of Yoga and Allied Sciences, 14(1), 118–130.
- [154] Singh, V., & Shah, S. R. (2025). Integrating evidence-based teaching in yoga and Ayurveda: Bridging tradition with modern pedagogy. International Journal of Yogic, Human Movement and Sports Sciences, 10(1), 141–145.
- [155] Somveer, & Shah, S. R. (2024). Bioinspired mathematical modeling of chemical dispersion in narrow and curved arteries: A computational approach. International Journal of Mathematical Archive, 15(11), 1–9.
- [156] Upadhyay, A. K., & Shah, S. R. (2025). Modeling and analysis of atmospheric pollution dispersion under distance-dependent wind and constant removal. International Research Journal of Modernization in Engineering Technology and Science, 7(5), 547–552.
- [157] Upadhyay, A. K., Vashisth, M., Kaur, A., & Shah, S. R. (2025). Mathematical modeling of atmospheric pollutant dispersion under periodic emissions: Implications for respiratory and cardiovascular health. International Journal of Science, Engineering and Technology, 13(5).
- [158] Yadav, P., & Shah, S. R. (2024). Female domestic laborers in the urban informal economy: A case analysis of Delhi. International Research Journal of Modernization in Engineering Technology and Science, 6(8), 216–225.
- [159] Yadav, P., Sengar, N., & Shah, S. R. (2024). Economic conditions and age profile of women domestic workers in Delhi's urban informal sector. International Journal of Research Publication and Reviews, 15(8), 494– 500.
- [160] Yadav, P., Sengar, N., & Shah, S. R. (2025). An analysis of occupational health risks and outcomes among female agricultural laborers in India. International Journal of Progressive Research in Engineering Management and Science, 5(2), 1202–1211.
- [161] Yadav, P., Sengar, N., & Shah, S. R. (2025). Analysing occupational health issues among female farm laborers in India. International Journal of Science and Management Studies, 8(2), 105–114.
- [162] Quddus, R., & Shah, S. R. (2025). Natural compounds as potential breast cancer therapeutics: Insights from meta-analysis and computational approaches. Research Review: International Journal of Multidisciplinary, 10(10), 218–225. https://doi.org/10.31305/rrijm.2025.v10.n10.024.
- [163] Naveen, & Shah, S. R. (2025). Air pollution level prediction and comparative analysis of machine learning models: A case study of Delhi AQI. Research Review: International Journal of Multidisciplinary, 10(11), 266– 272. https://doi.org/10.31305/rrijm.2025.v10.n11.027.
- [164] Upadhyay, A. K., & Shah, S. R. (2025). Machine learning-based prediction of air quality index (AQI) in Mumbai: Comparative analysis of linear regression, random forest, and XGBoost models. Research Review: International Journal of Multidisciplinary, 10(11), 299–307. https://doi.org/10.31305/rrijm.2025.v10.n11.030.
- [165] Singh, A., & Shah, S. R. (2025). Mathematical modelling of blood flow: Analysing the impact of arterial stenosis and nanoparticle suspensions. Research Review: International Journal of Multidisciplinary, 10(11), 308–320. <a href="https://doi.org/10.31305/rrijm.2025.v10.n11.031">https://doi.org/10.31305/rrijm.2025.v10.n11.031</a>.
- [166] Singh, V., Yadav, K., Khute, U. K., & Shah, S. R. (2025). Harmonizing tradition and science: An evidence-based educational approach to yoga and ayurveda. Research Review: International Journal of Multidisciplinary, 10(11), 288–298. https://doi.org/10.31305/rrijm.2025.v10.n11.029.
- [167] Quddus, R., & Shah, S. R. (2025). Natural compounds as potential breast cancer therapeutics: Insights from meta-analysis and computational approaches. International Journal of Multidisciplinary Research Review, 11(10), 218–225.
- [168] Singh, A., & Shah, S. R. (2025). Mathematical modelling of blood flow: Analysing the impact of arterial stenosis and nanoparticle suspensions. International Journal of Multidisciplinary Research Review, 11(10), 308–320.

- [169] Upadhyay, A. K., & Shah, S. R. (2025). Machine learning-based prediction of air quality index (AQI) in Mumbai: Comparative analysis of linear regression, random forest, and XGBoost models. International Journal of Multidisciplinary Research Review, 11(10), 299–307.
- [170] Singh, V. S. R., Yadav, K., & Khute, U. K. (2025). Harmonizing tradition and science: An evidence-based educational approach to yoga and Ayurveda. International Journal of Multidisciplinary Research Review, 11(10), 288–298.
- [171] Naveen, & Shah, S. R. (2025). Air pollution level prediction and comparative analysis of machine learning models: A case study of Delhi AQI. International Journal of Multidisciplinary Research Review, 11(10), 266–274.

## 9.Conflict of Interest

The authors declare that there are no conflicts of interest associated with this article.

# 10.Funding

No funding was received to support this study.