

# Menstrual Hygiene Management: An Overview of Global Awareness

Yachana Mishra\*

School of Bioengineering and Biosciences, Lovely Professional University, Phagwara-144411, Punjab, India

\*Corresponding author: [yachanamishra@gmail.com](mailto:yachanamishra@gmail.com)

**Abstract.** In developing nations, menstrual hygiene management (MHM) is a problem that is frequently disregarded. Women and girls who are menstruating are compelled to live in seclusion, are subject to mobility limitations and dietary restrictions, and may be barred from engaging in daily activities. Due to its relationship with social and cultural components of a natural process that is sometimes shrouded in ingrained shame and taboos, menstrual hygiene waste management has not gotten enough attention and, as a result, has not been adequately researched. As a result, information on the amounts and whole lifespan of the created trash is either lacking or fraught with uncertainty. However, this work raises important and pertinent issues that may impact on the environment as well as the health, equality, and dignity of women. The present review also identifies the knowledge gaps that still need to be filled and offers potential solutions for the near future. Menstrual hygiene requires immediate consideration in the context of a pandemic, as does understanding the potential role that waste produced, for instance, in refugee camps, may have in spreading SARS-CoV-2. The current analysis suggests potential intervention tactics intended to remedy this ignorance. In order to achieve Sustainable Development Goals (SDG) 3.7 and 6.2, which address women's healthcare and hygiene requirements, there looked to be room for interventions through a coordinated national effort to promote awareness of MHM among women utilizing a variety of media outlets.

## 1 Introduction

The need and urgency to address the issues related to menstrual hygiene waste, cannot still be viewed as solely being a concern in developing nations. It provides context for the garbage generated by migrants in the settling regions, which is sometimes overlooked when implementing sanitation programmes [1]. Translational medicine, imaging and sampling methods, patient-centric analysis of menstrual disorders like abnormal uterine bleeding, as well as fundamental endometrial biology like tissue engineering and omic analysis of the endometrium, stem cells and fibroids, are all necessary for advancing menstruation science [2].

Adolescents, as per World Health Organization (WHO), are those between the ages of 10 and 19 [3]. The kid develops physically, psychologically, and biologically during this time, and the menarche of women ushers in the reproductive phase of their life that is a significant biological turning point. India has been used as an example because there are 355 million menstruating women and girls. Many still encounter significant obstacles to having a comfortable and dignified menstrual experience, such as a lack of access to appropriate fresh water and washing facilities and affordable sanitary products. Stigmatization due to social and religious factors can be severe [4].

Unfortunately, there is very little literature on menstrual hygiene waste (MHW), and it is clear that there aren't any good, thorough studies that present and address the environmental issues related to MHW management. The debates have been dominated by women's experiences (mostly adolescent girls), especially those linked to managing menstruation. Particular emphasis has been paid to the implications associated to the gendered features of sanitation-related psychological stress [5-8]. Only a small number of articles discuss potential environmental problems brought on by MHW in general terms [9]. According to one study, a woman discards between 125 and 150 kg of sanitary waste in her lifetime, including menstrual cups, internal absorbents, pads, and cloth pads. Considering the number of women worldwide, this means that the yearly amount of MHW produced may be between 250 and 300 million tonnes [10]. However, there are no statistics on how much equivalent trash is produced by women in emergency situations, such as by migrants and/or refugees.

In order to achieve Sustainable Development Goals 3.7 and 6.2, which address women's healthcare and hygiene requirements, there looked to be room for interventions through a coordinated national effort to promote awareness of MHM among women utilising a variety of media outlets [11]. Due to a lack of access to reliable information and appropriate understanding, most women and girls frequently have difficulties with menstruation hygiene [12]. Menstruation ignorance may lead to risky hygiene practices, which increase the risk of reproductive and urinary tract infections, cervical cancer, subpar academic achievement, and overall negative quality of life [13].

## 2 Menstrual Hygiene Waste

For productive and healthy lives, women, girls, and transgender people need clean menstruation supplies such as sanitary pads, menstrual cups, and tampons. Although women's menstrual hygiene procedures should be straightforward, a sizable population lacks enough hygiene knowledge or lives in dangerous circumstances [1].

The preferred sanitary protection material depends on the individual's preferences, cultural tolerance, financial situation, and market accessibility. To manage menstruation hygiene, one should be provided with soap and period absorbents in addition to basic sanitation facilities. Different absorbents are preferred by urban and rural women and girls [14].

Nowadays, there are several rayon-based synthetic fibre sanitary solutions on the market, both deodorised and undeodorized. These deodorised goods include substances with antibacterial properties like organochlorines. Due to their chemical makeup, these goods destroy the soil's microorganisms when buried in the ground and slow down the decomposition process [15].

Only an estimate of the MHW produced in some countries is given in the literature [16]. Several articles detail inappropriate methods for disposing of MHW, mostly in low- and middle-income nations [16]. The majority of these works, however, are based on survey data and aimed to comprehend disposal methods; hence, the environmental effects of the created waste are virtually not provided or analysed. The benefits of employing reusable disposal products have been boosted. Researchers suggested the use of biodegradable absorbent products, especially for women of poor nations [17,18]. Different types of menstrual hygiene products for women are presented in fig. 1[14].

According to market statistics, the consumption of women hygiene products is substantially lower in low-income nations. More than 65% of French women use single-use pads and tampons, compared to 7.7% who occasionally use washable sanitary towels [19]. According to recent literature, 1,470 kg should be consumed every month; If women with critical conditions are taken into account, the recommended value may be thought of as more credible as it agrees with the French market data [20]. Given the migratory scenario, it equates to an average worldwide quantity of 67 kg of sanitary waste throughout the course of a woman's lifetime, which is almost half of the waste value often suggested for a woman [10]. Using data taken from the International Migrant Stock 2020 database, the geographic flux of female migrants (aged 10 to 49, then generating MHW) was assessed taking into account both their origin and destination locations. The average volume per woman was found to be 1.5 Kg worldwide [21]. In France, more than 25% of women experienced menstruation precariousness at some point in their lives, primarily due to the menstrual protection products utilised. Menstrual precariousness is regarded by 76% of French women as a public health problem [1].



Fig. 1 Different Types of Menstrual Hygiene Products for Women

### 3 Menstrual Hygiene Waste: Environmental Concerns

The menstrual items that are used the most frequently include absorbents, such as sanitary pads, tissue paper, and fabric, all of which may be prepared at home [22]. Compared to disposable pads, cloth pads are less harmful to the environment. However, as it requires privacy and access to water, cleaning them can be extremely difficult under difficult circumstances, such as for women of poor nations. In that case, disposable pads are typically recommended, if offered. The majority of menstrual hygiene products frequently contain residuals, such as volatile organic compounds, as a result of increased ingredient disclosure [23].

Some of those, like acrylate, can cause the polymer network to emit potentially hazardous monomers or additives. Other items contain pesticides including atrazine[17], pyrethrum, and procymidone that can cause acute and long-term aquatic toxicity and can also come from natural fibres like cotton [14].

It is also crucial to emphasise that burning the trash accumulation sites might release harmful air pollutants, include dangerous substances including polychlorinated dibenzodioxins, and cause groundwater pollution through leaching. The consequences of the unchecked spread of MHW in the environment are absolutely unknown in the pandemic situation with the viral comeback caused by SARS-CoV-2 subtypes. Particularly, the lower genital tract of a woman is exposed to many germs, which may potentially cause a build-up of microorganisms and/or endotoxins in the menstrual fluid. Although it has been demonstrated that SARS-CoV-2 may live for many days outside of the human body[24], there have been no investigations concerning the potential involvement of MHW in COVID-19 infection. In instance, it has already been observed that incorrect disposal of such garbage might spread the HIV infection [25].

### 4 Menstrual Hygiene Waste: Gynaecologic Concerns

Girls with physical and developmental disabilities, as well as their families and caregivers, may experience serious problems related to puberty and menstruation, such as unintended pregnancies, abuse risk, vulnerability, difficult MHM, dysmenorrhea, abnormal uterine bleeding, behavioral issues/mood concerns, or changes in seizure pattern. During this time of life, healthcare professionals may have a significant and beneficial influence on both teenagers and their families/caregivers. After obtaining a thorough history from the patient and the person providing treatment, it should be determined whether menstrual manipulation is necessary to assess the impact of present issues on quality of life. Realistic expectations should be addressed and full amenorrhea's difficulty should be explained. Depending on the needs of each patient, the objectives for the management of menstruation issues should be a decrease in the amount and total days of menstrual flow, a reduction in monthly discomfort, and a suppression of ovulatory or cyclic symptoms. The benefits and drawbacks of the various treatment options are represented in table. 1 [26].

**Table. 1** Benefits and drawbacks of various treatment methods in menstruation issues

S.No.	Treatment	Benefits	Drawbacks
1	Levonorgestrel releasing intrauterine device (IUD)	<ul style="list-style-type: none"> <li>• High amenorrhea achievement</li> <li>• Insertion once every 3-5 years</li> </ul>	<ul style="list-style-type: none"> <li>• Breakthrough bleeding</li> <li>• Need for general anaesthesia for insertion</li> </ul>
2	Vaginal ring	<ul style="list-style-type: none"> <li>• Monthly use</li> <li>• Can be used as extended or continuous</li> </ul>	<ul style="list-style-type: none"> <li>• Placement may need assistance</li> <li>• Drug interactions with some anti-epileptic drugs</li> <li>• Increased risk of venous thromboembolism (VTE) in immobilized patients</li> </ul>
3	Patch	<ul style="list-style-type: none"> <li>• Weekly use</li> <li>• Can be used as extended or continuous</li> </ul>	<ul style="list-style-type: none"> <li>• Drug interactions with some anti-epileptic drugs</li> <li>• Increased risk of VTE in immobilized patients</li> <li>• The patches can be removed by the patients</li> </ul>
4	Oral progestins	<ul style="list-style-type: none"> <li>• Decreased flow</li> </ul>	<ul style="list-style-type: none"> <li>• Drug interactions with some anti-epileptic drugs</li> <li>• Breakthrough bleeding</li> <li>• Need to take daily medication</li> </ul>
5	Nonsteroidal anti-	<ul style="list-style-type: none"> <li>• Decreased flow and</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal problems</li> </ul>

	inflammatory drugs (NSAIDs)	pain	
6	Combined oral contraceptives (COCs)	<ul style="list-style-type: none"> <li>• Can be used as extended or continuous</li> </ul>	<ul style="list-style-type: none"> <li>• Drug interactions with some anti-epileptic drugs</li> <li>• Increased risk of VTE in immobilized patients</li> <li>• Need to take daily medication</li> </ul>

## 5 Menstrual Health and Hygiene Management

Menstrual cups and other reusable items have already been mentioned in literature as having the potential to greatly reduce the amount of MHW burned or disposed of in landfills [27]. Menstrual cups in particular are constructed of medical-grade silicone rubber, which can be recycled and disinfected. Tampons, on the other hand, have a significant negative influence on resource depletion and eutrophication, while disposable pads have a great effect on the change of climate [17].

Pyrolysis or incineration may be used, primarily during the pandemic [28]. This, when compared to landfill, makes it possible to minimise the amount and increase the safety of MHW [27]. India, where there is a substantial amount of this MHW, has previously encouraged this treatment (about 113,000 tonnes annually) [19].

In a study, five Junior High Schools in the Kumbungu area of northern Ghana, 250 adolescent schoolgirls provided quantitative data, while thirty students, five instructors, and five schoolboys provided qualitative data. In order to identify the determinants of inadequate menstruation knowledge, binary logistic regression models were built. Themes were created via coding, verbatim transcribing, and organising qualitative data. 53.6% of the girls exhibited a general lack of awareness regarding menstruation. The majority of the boys had heard of and had some understanding of menstruation, with the majority defining it as "the flow of blood via the vagina of a female." The guys indicated that in the schools and the society, menstruation is referred to as "Vodafone," "Red card," and "Palm oil." socioeconomic variables. There is evidence that girls in their late adolescence are less likely to be ignorant about their periods than girls between the ages of 10 and 14. Poor menstruation knowledge was defended against by maternal education. Teenagers who received basic education from their mothers and secondary or higher education from their mothers were less likely to have inadequate understanding about menstruation than those whose mothers were illiterate. Teenagers from families without televisions or radios were more likely to be ignorant about the menstrual cycle than those from homes with these amenities [29].

Their primary selection criteria for sanitary items were comfort, safety, and affordability. The majority of the instructors claimed that, even in dire situations, pupils are not given access to sanitary supplies in classrooms. Girls are considered dirty and impure when menstruating, and open talks about menstruation and its management are discouraged. Starting in elementary school, menstrual education might be incorporated into the regular curriculum to help girls get ready for menarche, increase their awareness of the menstrual cycle, and educate males how to support girls and women during this time. Additionally, this could dispel prevailing societal stereotypes about menstruation [29].

The provider survey had a response rate of 65%; 15% of doctors often inquired about menstruation products from patients, whereas 44% were worried that patients wouldn't be able to afford them. The patient survey had an 85% response rate; respondents experienced menstrual hygiene insecurity in 19% of cases, missed commitments in 55% of cases, and addressed menstruation products with providers in 45% of cases. Ten qualitative interviews with the fifteen patients who agreed to participate were undertaken, and topic saturation set in. The value of thorough early menstrual health education and the involvement of providers in menstrual management were stressed in interviews. The teenage years are a vital time to begin receiving medical treatment [30]. Menstrual health education must be prioritised because stigmas associated with menstruation may restrict access to healthcare [31].

To determine the obstacles to menstrual hygiene, it is important to understand the beliefs and customs around menstruation in a rural Haryana community. Following IDI and FGD, a barrier to regular sanitary pads' accessibility is teenage girls' lack of knowledge about menstruation hygiene. The lack of sanitary pad disposal facilities in schools and the bad state of the restrooms raised concerns about student absence. Menstrual health education and the Adolescent Reproductive Sexual Health programme can boost usage and lessen stigma and misinformation. Separate restrooms for girls and a continuous, free supply of sanitary pads through Anganwadi would improve accessibility and lower absenteeism [32].

India, Kenya, Senegal, and the United States are the four nations where there have been changes.[33] It is based on an examination of 34 policy texts and interviews with 85 people involved in policy-making.[34] A common policy focus across nations is on things that can be seen and touched, such menstruation products and facilities, and is motivated by a

limited understanding of menstrual needs as the control of bleeding.[35] Policy-makers were motivated to maintain this focus by a variety of factors, including the dominant narrative of menstruation pads as a believed remedy for school absence paired with media sensationalization and the desire for quantitative outcomes.[36] Because menstruation is still seen as a problem that has to be controlled, repaired, and disguised, menstrual stigma continues to limit policy-makers and campaigners.[37] In order to address the needs of menstruators and remove institutional hurdles that are mostly entrenched in menstrual stigma, it is necessary to build capacity for a holistic menstrual policy landscape [38]. Safe management of menstrual hygiene practises and related elements among female high school students in central Ethiopia's public schools. 28.20% of women managed their menstrual hygiene safely [39].

## 6 Conclusion

Menstrual hygiene waste may have a serious health and psychological impact on teenagers, but managing women's menstrual products is also a major problem across the world. Several information gaps persist despite the fact that they can impact both human and environmental health, making them a crucial component of disease prevention and health promotion. Due to the vast majority of people worldwide living in subpar conditions, such as migrants in camps in Europe, the issues related with inadequate waste management cannot, however, still be regarded limited to low-income nations. Adolescent females have poor MHM practises, which were found to be influenced by the people that adolescent girls lived with, their parents' occupations, their place of residence, and whether or not there was a container available in the school restrooms for disposing of sanitary napkins. Female students must receive behavioural change messaging on menstrual hygiene. The majority of teenage schoolgirls had inappropriate hygiene habits and little awareness about menstruation. This indicates the need for initiatives to enhance understanding and encourage safe hygiene behaviour among adolescent schoolgirls during menstruation.

Although school-aged teenagers have a reasonable amount of information about managing menstrual hygiene, attitudes and practises still need to be improved. Findings show that behaviour change communication campaigns and constant reinforcement of school health education programmes are both necessary.

For females with physical and developmental impairments and their families/caregivers, puberty and menstruation are sometimes complicated processes. The management of these individuals can greatly benefit from premenarchal counselling, but no intervention or medical care is advised at this time. Using a variety of hormonal techniques, menstrual issues that influence quality of life in the post-menarche era can be successfully treated. The success and duration of the therapy are increased by a thorough description of the reasonable expectations for the treatment as well as the benefits and drawbacks of the current approaches.

## 7 References

- [1] Anand, Utpal, Meththika Vithanage, Anushka Upamali Rajapaksha, Abhijit Dey, Sunita Varjani and Elza Bontempi. "Inapt management of menstrual hygiene waste (MHW): an urgent global environmental and public health challenge in developed and developing countries". *Heliyon* 8 (2022):e09859.
- [2] Critchley, Hilary OD, Elnur Babayev, Serdar E. Bulun, Sandy Clark, Iolanda Garcia-Grau, Peter K. Gregersen, Aoife Kilcoyne, Ji-Yong Julie Kim, Missy Lavender, Erica E. Marsh, Kristen A. Matteson, Jacqueline A. Maybin, Christine N. Metz, Inmaculada Moreno, Kami Silk, Marni Sommer, Carlos Simon, Ridhi Tariyal, Hugh S. Taylor, Günter P. Wagner and Linda G. Griffith. "Menstruation: science and society". *American Journal of Obstetrics and Gynecology*223 (2020).
- [3] Programming for adolescent health and development. Report of a WHO/UNFPA/UNICEF study group on programming for adolescent health. World Health Organization Technical Report Series 886 (1999).
- [4] Kaur, Navpreet and Roger W. Byard. "Menstrual health management: practices, challenges and human rights violations." *Medico-Legal Journal*89 (2021).
- [5] Sommer, Marni. "Structural factors influencing menstruating school girls' health and well-being in Tanzania." *Compare: A Journal of Comparative and International Education* 43(2013).
- [6] Mohammed, Shamsudeen, and Roderick Emil Larsen-Reindorf. "Menstrual knowledge, sociocultural restrictions, and barriers to menstrual hygiene management in Ghana: evidence from a multi-method survey among adolescent schoolgirls and schoolboys." *Plos one* 15 (2020): e0241106.
- [7] Schmitt, Margaret L, Olivia R. Wood, David Clatworthy, Sabina Faiz Rashid and Marni Sommer. "Innovative strategies for providing menstruation-supportive water, sanitation and hygiene (WASH) facilities: learning from refugee camps in Cox's bazar, Bangladesh." *Conflict and Health* 15 (2021).
- [8] Sahiledengle, Biniyam, Daniel Atlaw, Abera Kumie, Yohannes Tekalegn, Demelash Woldeyohannes and Kingsley Emwinyore Agho. "Menstrual hygiene practice among adolescent girls in Ethiopia: a systematic review and meta-analysis." *PloS one* 17 (2022): e0262295.
- [9] Bhagwat, Ankita, and Parisha Jijina. "A psychosocial lens on an indigenous initiative to address menstrual health and hygiene in indian villages." *Social Work in Public Health* 35 (2020).

- [10] Bharadwaj, Sowmyaa, and Archana Patkar. "Menstrual hygiene and management in developing countries: Taking stock." *Junction Social* 3 (2004).
- [11] Afiaz, Awan, and Raaj Kishore Biswas. "Awareness on menstrual hygiene management in Bangladesh and the possibilities of media interventions: using a nationwide cross-sectional survey." *British Medical Journal Open* 11 (2021): e042134.
- [12] Dutta, Devashish, Chander Badloe, Hyunjeong Lee and Sarah House. "Supporting the rights of girls and women through menstrual hygiene management (MHM) in the east asia and pacific region: realities, progress and opportunities". UNICEF East Asia and Pacific Regional Office (EAPRO), Bangkok, Thailand (2016).
- [13] Belayneh, Zelalem, and Birhanie Mekuriaw. "Knowledge and menstrual hygiene practice among adolescent school girls in southern Ethiopia: a cross-sectional study." *BMC public health* 19 (2019).
- [14] Kaur, Rajanbir, Kanwaljit Kaur, and Rajinder Kaur. "Menstrual hygiene, management, and waste disposal: practices and challenges faced by girls/women of developing countries." *Journal of environmental and public health* (2018).
- [15] Kroesa, Renate. "The Greenpeace guide to paper". Greenpeace Canada (1990).
- [16] Robinson, Hannah Jayne, and Dani Jennifer Barrington. "Drivers of menstrual material disposal and washing practices: A systematic review." *Plos one* 16 (2021): e0260472.
- [17] Hait, Amy, and Susan E. Powers. "The value of reusable feminine hygiene products evaluated by comparative environmental life cycle assessment." *Resources, Conservation and Recycling* 150 (2019): 104422.
- [18] Foster, Jasmin, and Paul Montgomery. "A study of environmentally friendly menstrual absorbents in the context of social change for adolescent girls in low-and middle-income countries." *International Journal of Environmental Research and Public Health* 18 (2021): 9766.
- [19] Sasidaran, Sarani, Prateek Kachoria, Antony Raj, Sudha Ramalingam, Brian R. Stoner, Katelyn L. Sellgren, and Sonia Grego. "Physical properties of menstrual hygiene waste as feedstock for onsite disposal technologies." *Journal of Water, Sanitation and Hygiene for Development* 11 (2021).
- [20] Velasco Perez, Maribel, Perla Xochitl Sotelo Navarro, Alethia Vazquez Morillas, Rosa María Espinosa Valdemar, and Jéssica Paola Hermoso Lopez Araiza. "Waste management and environmental impact of absorbent hygiene products: A review." *Waste Management & Research* 39 (2021).
- [21] Yildiz, Dilek, and G. J. Abel. "Migration stocks and flows: data concepts, availability and comparability." *Research Handbook on International Migration and Digital Technology* (2021).
- [22] Elledge, Myles F., Arundati Muralidharan, Alison Parker, Kristin T. Ravndal, Mariam Siddiqui, Anju P. Toolaram, and Katherine P. Woodward. "Menstrual hygiene management and waste disposal in low and middle income countries—a review of the literature." *International Journal of Environmental Research and Public Health* 15 (2018): 2562.
- [23] Lin, Nan, Ning Ding, Emily Meza-Wilson, Amila ManuradhaDevasurendra, Christopher Godwin, Sung Kyun Park, and Stuart Batterman. "Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks." *Environment international* 144 (2020): 105740.
- [24] Anand, Utpal, Xuan Li, Kumari Sunita, Snehal Lokhandwala, Pratibha Gautam, S Suresh, Hemen Sarma, Balachandrar Vellingiri, Abhijit Dey, Elza Bontempi and Guangming Jiang. "SARS-CoV-2 and other pathogens in municipal wastewater, landfill leachate, and solid waste: A review about virus surveillance, infectivity, and inactivation." *Environmental Research* 203 (2022): 111839.
- [25] Pachauri, Ash, Prerna Shah, Bethanie C. Almoth, Norma P.M. Sevilla and Manjula Narasimhan. "Safe and sustainable waste management of self care products." *British Medical Journal* 365 (2019).
- [26] Dural, Özlem, İnci Sema Taş, and Süleyman Engin Akhan. "Management of menstrual and gynecologic concerns in girls with special needs." *Journal of Clinical Research in Pediatric Endocrinology* 12 (2020): 41.
- [27] Thurairasu, Vanitha. "Menstrual hygiene management (MHM) and the way forward-a brief review." *European Journal of Medical and Health Sciences* 5 (2023).
- [28] AlDayyat, Ebtihal A., Motasem N. Saidan, Zayed Al-Hamamre, Mohammad Al-Addous, and Malek Alkasrawi. "Pyrolysis of solid waste for bio-oil and char production in Refugees' camp: a case study." *Energies* 14 (2021): 3861.
- [29] Mohammed, Shamsudeen, and Roderick Emil Larsen-Reindorf. "Menstrual knowledge, sociocultural restrictions, and barriers to menstrual hygiene management in Ghana: evidence from a multi-method survey among adolescent schoolgirls and schoolboys." *Plos one* 15 (2020): e0241106.
- [30] Trant, Amelia A., AllaVash-Margita, Deepa Camenga, Paula Braverman, Denise Wagner, Mariana Espinal, Edwina P. Kisanga, Lisbeth Lundsberg, Sangini S. Sheth, and Linda Fan. "Menstrual health and hygiene among adolescents in the United States." *Journal of Pediatric and Adolescent Gynecology* 35 (2022): 277-287.
- [31] Ramaiya, Astha, and Suruchi Sood. "What are the psychometric properties of a menstrual hygiene management scale: a community-based cross-sectional study." *BMC Public Health* 20 (2020).
- [32] Parija, Pragyan Paramita, Nitika Sharma, Harshal R. Salve, Rakesh Kumar, Kapil Yadav and Suprakash Mandal. "A qualitative study regarding menstrual hygiene in a rural community of Haryana, India." *Journal of Tropical Pediatrics* 68 (2022): fmac083.
- [33] Alhelou, Nay, Purvaja S. Kavattur, Lillian Rountree and Inga T. Winkler. "We like things tangible: A critical analysis of menstrual hygiene and health policy-making in India, Kenya, Senegal and the United States." *Global Public Health* 17 (2022).

- [34] Deriba, Berhanu Senbeta, Girma Garede, Diriba Gameda, Tinsae Abeya Geleta, Kemal Jemal, Elias Teferi Bala, Mulugeta Mekuria, Tadesse Nigussie, Dejene Edosa Dirirsa and Elisabeth Legesse. "Safe menstrual hygiene management practice and associated factors among female adolescent students at high schools in central Ethiopia: A mixed-method study." *Frontiers in Public Health* 10 (2022).
- [35] Kapoor, B., Singh, S.K., Gulati, M., Gupta, R. and Vaidya, Y., 2014. Application of liposomes in treatment of rheumatoid arthritis: quo vadis. *The scientific world Journal*, 2014.
- [36] Kalkal, A., Kumar, S., Kumar, P., Pradhan, R., Willander, M., Packirisamy, G., Kumar, S. and Malhotra, B.D., 2021. Recent advances in 3D printing technologies for wearable (bio) sensors. *Additive Manufacturing*, 46, p.102088.
- [37] Gupta, V.K., Guo, C., Canever, M., Yim, H.R., Sraw, G.K. and Liu, M., 2014. Institutional environment for entrepreneurship in rapidly emerging major economies: the case of Brazil, China, India, and Korea. *International Entrepreneurship and Management Journal*, 10, pp.367-384.
- [38] Khamparia, A., Bharati, S., Podder, P., Gupta, D., Khanna, A., Phung, T.K. and Thanh, D.N., 2021. Diagnosis of breast cancer based on modern mammography using hybrid transfer learning. *Multidimensional systems and signal processing*, 32, pp.747-765.
- [39] Kaswan, M.S. and Rathi, R., 2020. Green Lean Six Sigma for sustainable development: Integration and framework. *Environmental impact assessment review*, 83, p.106396