

Knowledge on female hygiene and its associated diseases: a mini review

Knowledge on female hygiene

Koyeli Girigoswami, Agnishwar Girigoswami, A. Harini and J. Thanujashree

Medical Bionanotechnology, Faculty of Allied Health Sciences, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kanchipuram, India

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Abstract

Purpose – Menstruation is a part of the female reproductive cycle that begins with adolescence. Menstruation is a natural change; it relates to several malpractices and misconceptions that may contribute to adverse health outcomes.

Design/methodology/approach – The authors have searched relevant papers using Google Scholar and PubMed to write this mini review.

Findings – During menstruation, poor hygiene maintenance can cause serious illness, which includes the urinary tract and reproductive tract infection. Menstruation management is a hygienic system, and it is essential for females because poor hygiene maintenance during menstruation can cause some infections and numerous sexually transmitted diseases. There are a few nanotechnology-based products that have come into the market to offer some relief to females during their periods.

Originality/value – This mini review will help researchers to design innovative female hygiene products that can relieve the discomfort caused to women during their reproductive age.

Keywords Female hygiene, Sanitary products, Urogenital tract diseases, Intimate hygiene products, Nanotechnology

Paper type Literature review

1. Introduction

Hygiene significantly prevents diseases and infection and avoids undesirable odor that also enhances the confidence and quality of life of females (Sivakumar, 2016). Menstruation is a part of the female reproductive cycle that begins with adolescence. Menstruation is a usual change, and it is connected with numerous malpractices and misconceptions that may contribute to adverse health consequences. Numerous women have experienced difficulties throughout menstruation, which include stomach pain, headache, joint pain, painful breasts, etc. During menstruation, hygiene is an essential part of health education in a woman's life. Different conditions such as pathology, psychology and physiology of menstruation are linked with women's health and can also lead to several diseases that can be incurable. Hence, it is a major problem regarding the mortality and morbidity of the female population (Tegegne & Sisay, 2014).

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Menstrual hygiene defines a particular medical care that is needed for women's monthly menstrual cycle. During menstruation, poor hygiene maintenance can cause serious illness, which includes the urinary tract and reproductive tract infection. Infection of the reproductive tract is a silent epidemic that can affect women's lives because of the improper maintenance of menstrual hygiene. Each year nearly 10% of women are susceptible to genital infections along with bacterial vaginitis and urinary tract infections (Pokhrel, Mahantashetti, Angolkar, & Devkota, 2014; Sivakumar, 2016). Poor hygiene along with pregnancy is the risk factors for vaginal infection. The improper use of sanitary napkins can cause trouble in the menstrual areas such as sudden blood leakage and pain. The majority of women change absorbent material during the night, whereas a few percent of women changed their pads at midnight because of over bleeding. The number of sanitary napkins used by women depends on the menstrual flow of the person (Sivakumar, 2016). We have searched relevant papers using Google Scholar and PubMed to write this mini review.

1.1 Importance of female hygiene

Hygiene maintenance indicates washing the external part such as genitalia using the vaginal wash through the menstrual period, which must be followed by hand wash with the help of soap. After using the toilet, the external genitalia are frequently washed, which gives a good result. Around 1.61% of women had poor washing. Bathing is a part of personal hygiene, and half of the people utilized water to clean while few people used soap and water, and some people used vaginal wash. During the menstrual cycle, proper hygiene maintenance is needed to change the sanitary napkins each 3–4 hours to prevent diseases as well as avoid foul odor, itching, and rashes. Hygiene and pH are maintained by external genitalia due to the mechanism of release of our own body. Soaps or other harsh cleaners are not to be used intravaginally as they may change the pH. Women should use only water as well as vaginal washes because they don't change the pH. About 51% of girls know about menstruation and its management. Only 33% of girls utilized pads as absorbent material during menstruation. The disposal of used sanitary napkins is essential because it spoils the surrounding nature and also causes air pollution due to the burning of pads (Sivakumar, 2016). However, girls have knowledge about the removal of sanitary napkins as menstrual absorb, and many of them utilized homemade cloth. Deficiency of money and some people do not know how to use pads are the reasons for fewer people using sanitary napkins. The cotton sanitary pads are burned in rural areas because they have vacant space. Moreover, in urban areas, people discard the used sanitary napkins in drainage together with domestic waste, which can block the drainage system. The soiled sanitary pads are discarded in vacant areas and in that place the microorganisms can develop, which affects our pets to get the disease as well as affect the microbiota of the soil (Tegegne & Sisay, 2014). The pattern and duration of the menstrual period and amount of blood flow were analyzed, and the outcome of the study showed that regular menses was among 82% of girls and 65% of girls had moderate blood flow while 18% of girls had an abnormal menstrual cycle (Deshpande, Patil, Gharai, Patil, & Durgawale, 2018).

1.2 Some malpractices of hygiene during menstruation

The girls had no knowledge about the disposal of sanitary pads; 51.67% of girls wrapped the used pads in the paper, nearly 30% of the adolescent girls wash the sanitary napkins and then throw them in a dustbin and 18.4% of girls dispose of their sanitary pads in the open. Practices of personal hygiene such as bathing, hand washing and private parts cleaning play an important role in self-protection from infection or disease. After utilizing the toilet, hand wash with soap and water can be beneficial. Every woman succeeds in practicing hand washing during menses. They used water and soap (78%), but few (22%) women utilized only water. During menses, a few (4%) girls also do hair washing daily (Deshpande *et al.*, 2018).

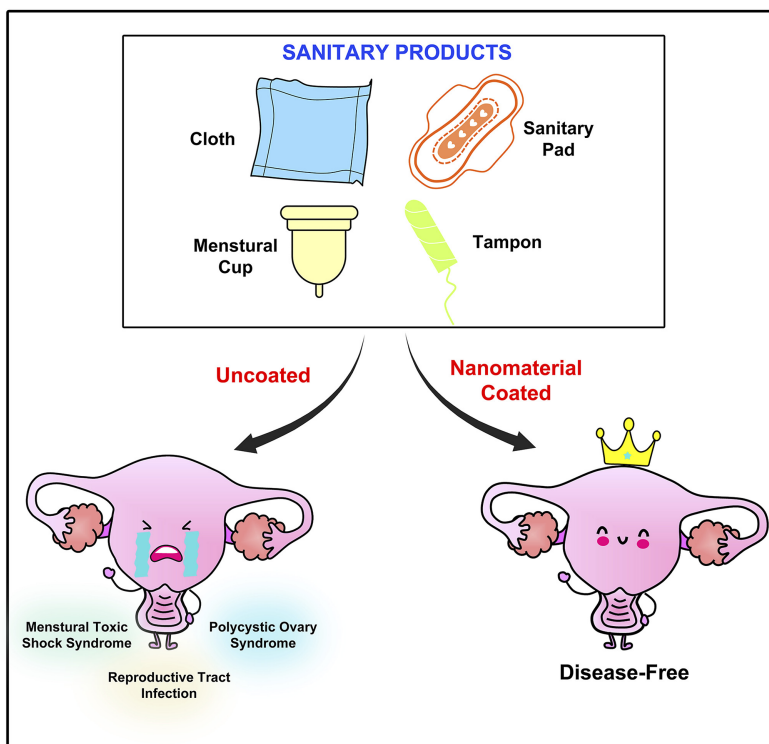
Still, menstruation is regarded as dirty and unclean in Indian society. The response to menstruation is dependent on knowledge and awareness regarding menstruation. The process of understanding menstruation in a girl and its related changes influences her reaction to menarche (Rao, Joshi, & Kanade, 1998). Menstruation is a common physiological event for females indicating their ability for procreation. However, for every young woman, this menstruation is a challenging phenomenon. Menstruation is often related to some degree of embarrassment and suffering by the society. Normally, every woman will experience any one type of menstrual problem in her lifetime. The predominance of menstrual disorders is recorded as 87% (Narayan, Srinivasa, Pelto, & Veerammal, 2001).

In India, the culture of silence has dominated our society resulting from a long-standing prohibition attached to menstrual hygiene practices. For girls, the adolescent period is a time of transition from childhood to adulthood or womanhood and it is a critical period of identity formation (Raina & Balodi, 2014). Menstruation is characterized by psychological, social, mental and physical changes that are censorious to well-being. The use of sanitary napkins remains low in both urban and rural communities in India. Until their first experience, young girls are not aware of menstruation because they are not educated about menstruation (Narayan *et al.*, 2001). In various cultures, women and girls are imposed with several restrictions; thus, it results in unsafe sanitary conditions and poor personal hygiene which leads to gynecological problems. The restrictions and isolation of girls during menstruation is being imposed on girls and it has strengthened the negative attitude toward menstruation (Dhingra, Kumar, & Kour, 2009). Still menstruating girls ignore hygienic health practices and scientific facts, important for maintaining good reproductive health which is due to social culture restrictions and taboos on menstrual practices. The major need of menstruating girls is to manage menstrual blood loss which can be done by utilizing absorbent pads. In developed countries, the sanitary pads are utilized universally whereas in India a large study reported that only 12% of the adolescent girls are utilizing sanitary pads and for 70% of the girls the cost of sanitary pads is the major barrier to utilizing them (Raina & Balodi, 2014).

During menstruation, three-fourths of women utilized the old cloth and only one-fifth of the women were utilizing the sanitary pads. It was perceived that the girls usually wash the cloth with detergent or soap after utilizing it, and the cloth is kept hidden in unhygienic places until the next menstrual period. Regular washing of the genital area and use of absorbent pads are essential during menstruation. The high cost of absorbent pads and the easy accessibility of cloth are the major reasons for utilizing cloth over absorbent pads. The use of absorbent material is of primary concern, and the infection is caused due to the reuse of material when it is poorly stored or improperly cleaned (El-Gilany, Badawi, & El-Fedawy, 2005). The current study showed that 59 (39.33%) women washed their external genital area with water and soap during the menstrual period, and greater than 45% of rural menstruating girls utilize only water to clean their external genitalia. They are not aware of maintaining the cleanliness of the external genitalia, which results in several infections and genital problems. Only a few women utilize antiseptic and water to clean the external genitalia which keeps them hygienic and safe from several genital problems since the antiseptics can effectively kill most of the bacteria and germs and also helps in preventing bacterial growth (El-Gilany *et al.*, 2005). Figure 1 shows the different health issues related to menstruation and misuse of sanitary napkins in women.

1.3 The different types of female reproductive system infections

Several internal and external factors influence the composition of vaginal microflora. These include age; hormonal fluctuations (such as those during menarche, menses and pregnancy); infections; and various external factors like sexual intercourse, the use of antibiotics, hygiene



Source(s): Figure by authors

Figure 1.
The various health complications in women that arise due to improper sanitary napkin usage

practices and hormone replacement therapy. Asian and White women are dominated by *Lactobacillus* sp. in 80.2% and 89.7% of their vaginal flora, respectively, while Hispanic and Black women are dominated by *Lactobacillus* sp. in 59.6% and 61.9%, respectively. The differences between ethnic groups may be partly explained by varying hygiene practices. It has been shown in a longitudinal study that the vaginal microbiome has remained stable throughout full-term, uncomplicated pregnancies regardless of the intervening species (the predominant species were *Lactobacillus crispatus* and *Lactobacillus iners*). There is an indication that a person's microbiome may be affected by the mode of birth (cesarean versus vaginal), which appears to affect immune development and may have longer-lasting effects. In terms of microbial diversity, this could have long-term implications. Dominguez *et al.* showed that the microbiome of the skin of infants born by cesarean delivery can be restored partially (through vaginal microbial transfer), to the level expected for infants following a birth mediated by the vagina. However, further studies are required to speculate the health benefits in the long term (Chen, Bruning, Rubino, & Eder, 2017; Dominguez-Bello *et al.*, 2016). Apart from vaginal infections, another undesirable effect of vaginal microbiome perturbation is that there can be an alteration of the innate immune system caused by bacteria, and the barrier properties of the epithelial lining of the vaginal can change in a species-specific way, which requires the host epithelial cells to distinguish between the commensal and pathogenic bacteria. There can be development and progression in the vulvovaginal area physiology caused due to these interactions. It is known that the first line of defense against genital tract infection is executed by the vulva. Although there is very less

known about the external vulvar microbial composition, it is anticipated that the upkeep of the microbiota ratio plays a pivotal role in overall vulvovaginal health. The different components of innate immunity of the vagina are the acidic pH of the vagina, the normal vaginal flora and the vaginal discharge. These altogether contribute to provide protection against vulvovaginal infections.

Several factors, like, hormonal changes, stress, immune deficiency or use of soap to clean the vagina or a vaginal douche, can upset the normal flora present inside the vagina and cause infections. Very little is known about the topic of intimate feminine hygiene in the medical literature, which made education a priority. Due to different cultural and religious practices, there are a lot of differences in the practice of feminine hygiene. Although it is known to everyone that good feminine hygiene is necessary and healthy, there are no systematic trials done so far to estimate the impact on health-related to vulvar hygiene. As the harsh soaps can cause irritation of the vulvar skin as well as mucous membranes, which can further provoke or exacerbate vulvar dermatitis, the wash products made for feminine hygiene must be formulated and need to be tested specifically in the vulvar area so that no skin irritation or sensitization is elicited. Thus, properly designed and scientifically tested female intimate hygiene products with vital attributes that include soap-free, hypoallergenic, pH-friendly protection against dryness, no irritants and mild cleanser, along with maintenance of stable natural vaginal microflora are warranted (Chen *et al.*, 2017).

Brown (1979) took an attempt to address the personal hygiene attentions of the female crew associate who lives in the space environment. She carefully designed the personal hygiene protocols including the related areas. These included the management of leg and underarm hair, menstrual management as well as urine collection facilities in the spacesuit (Brown, 1979; Czerwinski, 2019). There were limited literature available to address feminine hygiene practices, although sufficient literature were available on the following topics: textbooks on obstetrics gynecology, medicine-surgery, nursing fundamentals and women's health problems; manuals that addressed sex, etiquette and marriage. Many textbooks on the health of students of junior, high and secondary school were also available. Moreover, the health risk and wellness, health belief and self-care health practices literature were reviewed, but insignificant information about the practices of feminine hygiene was found (Czerwinski, 1996).

The lack of quantitative instrumentation to quantify female hygiene activities has restricted the amount of data available. Two parameters were specified: the first is specific personal health functions which include whole-body cleansing and oral hygiene that are documented in the Index of Activities of Daily Living (ADL) instrument scales. This ADL is measured in people who possess a compromised status of health. The second parameter is The Scorable Self-Care Evaluation (SSCE), which was established by Clark and Peters (1993). This assesses the female health practices in such women who have physical limitations. The poor reliability was found in a pilot study that included healthy individuals in the personal care and clothing section of the SSCE (Clark & Peters, 1993; Czerwinski, 1996).

2. Practices of feminine hygiene

Researchers have defined feminine hygiene practices as grooming and body care as the overall definition of feminine hygiene practices. Taking care of your body involves cleansing and removing waste from your body. There are several specific feminine hygiene activities, including bidet use, genitourinary hygiene, vaginal irrigation and perineal hygiene. There were descriptions of the methods for teaching women and girls personal hygiene practices, the importance of cleanliness and waste management, but no mention was made of the management of menstrual waste (Czerwinski, 1996, 2019). A comprehensive review describing the basic practices of female hygiene, and personal methods of genital care,

which included the various methods of bathing, douching and using tampons, was described by Budoff (1980). She described that there is no need for deodorant sprays if the genital zone can be properly rinsed using soap and water (Budoff, 1980). Simons has reviewed the practices of feminine hygiene specifically during menstruation and assessed the daily washing of the vulva and perineal area with water and soap. His study found that many women undergo the washing step of the vulva areas next to every elimination act. Simons recommended sincere attention was necessary to the external genitalia cleanliness, every time, especially when there is the presence of vaginal discharge. The use of internal sanitary protection was recommended only during normal menstruation that the hands should be washed before and after tampon insertion. When a woman is not menstruating, tampons should not be inserted because it may cause infections (Czerwinski, 1996; Simon, 1989). The subject's age and health-related concerns such as bladder control and repeated commercials in the news media could all affect their use of these items. The use of pantyliners may also be linked to the use of contraception or hormone replacement therapy. Estrogen-based contraceptives and osteoporosis prevention drugs may cause vaginal breakthrough bleeding or spotting, as well as menstrual flow alterations.

Research on feminine hygiene practices should also examine where and from whom these practices were initially learned. This knowledge will help healthcare providers improve women's self-care practices. The findings of this study provide a foundation for examining improvements in feminine hygiene practices and challenging assumptions about the importance of different feminine hygiene practices. The methods of body cleansing, feminine hygiene and menses control were investigated. Hand washing was discovered to differ depending on the bodily presence or basic feminine hygiene habits. When the woman was not menstruating, various menses control items were used for menses management. According to the findings of this report, healthcare professionals might be able to teach the women healthy and cost-effective healthcare activities such as not douching and hand washing before and after using menstrual management items to avoid infections (Czerwinski, 1996).

3. Management of hygiene during periods

Menstrual hygiene management in adolescent girls and women (18–45) of the age involves using hygienic material during periods to collect or absorb blood which can be altered in protection as regularly as important for the length of menstruation period. Water and soap are used to wash the body as needed and the facilities to access the disposal of used menstrual materials. Menstruation management is a hygienic system, and it is essential for females because poor hygiene maintenance during menstruation can cause some infections and numerous sexually transmitted diseases. It can lead to severe conditions such as cervical cancer (Deshpande *et al.*, 2018). In poor countries, menstruating women or girls find it difficult to find clean water for washing and private places to change the absorbing material. Many girls mainly use two types of absorbing materials that are cloth pads and commercially produced pads. Most girls used a piece of cloth material which are folded and adjusted inside the underwear. The cloth material is usually used by poor countries and the cloth can be reusable. Newspaper, leaves, toilet paper and cotton wool are blood-absorbing materials and are also used by many females because commercially produced pads are unaffordable (Crofts & Fisher, 2012).

3.1 Types of absorbents used during menstruation

During menstruation, the women must maintain hygiene. They use commercial products such as sanitary napkins, menstrual cups and tampons, which are available in the shop. The absorbent material can be soft, clean, required for the long run and protect their health.

Safety and comfort are the two main reasons women use sanitary napkins. The urban and rural women use various types of absorbent material (wood dust, hay dust, ashes, etc.) during periods. The reusable cloth pads (absorbent material) are mostly used in rural places and commercial sanitary pads are used in urban areas (Kaur, Kaur, & Kaur, 2018).

3.1.1 Reusable and washable cloth pads. The cloth pads are sustainable sanitary pads. The pads should be hygienically washed and can be dried using sunlight. Using a natural sterilizer (sun's heat) to dry the cloth pads, these pads can be made reusable and they are easily available, cost-effective, possess a high capacity to hold liquid, are comfortable and eco-friendly. To reuse the cloth pad and to avoid contamination, they are needed to be stored in hygienic dry places (Kaur *et al.*, 2018). More than 11,000 female hygiene products are used by women. Reusable pad usage can reduce disposable waste products. Likewise, they don't contain any harmful chemicals making the disposable pads good for the human body as well as the environment. Cloth pads are composed of breathable and soft fabrics that permit airflow. The reusable cloth pads have less irritation and sweating. When cloth pads are used, there are very few risks of getting an infection from yeast (Somwanshi, 2017).

3.1.2 Commercial sanitary pads. The commercial sanitary pads are very expensive compared to the ordinary cloth pads and it is either disposable or reusable. These pads are easily available at chemist shops, many stores or online. It is not eco-friendly because the cotton that is used to make the sanitary pads may not be 100% natural and it may contain some amount of pesticides (Kaur *et al.*, 2018).

3.1.3 Tampons. Tampon is a type of absorbent material that provides internal protection. In the vagina, a kind of soft material is inserted which absorbs the menstrual flow before it leaves the body. The reusable tampons are made of natural materials like cotton, wool, hemp or bamboo. They are not environmentally friendly, are very expensive and are not effectively degradable in nature (Billon *et al.*, 2020). Tampons, sponges and menstrual cups are blood-absorbing materials. Nowadays, very few percent of women or adolescent girls know about tampons and their uses. In real life, high prices lead to low demand, which is also an important limiting factor. The adolescent girls reported that the insertion products are difficult or painful or get stuck and due to this kind of fear, women do not use the tampons even if they are widely available. The insertion material is culturally unsuitable, with many women questioning their results on health and fertility (Crofts & Fisher, 2012).

3.1.4 Menstrual cups. The cups that are made of silicon, latex and rubber that help the cup gets inserted into the vagina, and the vessel is used to collect the menstrual blood, which can hold the blood volume (10–38 mL) are known as menstrual cups. Every 4–12 h, the cup must be emptied. There are two types of menstrual cups available depending on the blood flow, they are, a cervical cup, which is placed around the cervix, and a vaginal cup, which is generally a bell shape that is placed in the vagina. They are eco-friendly and reusable. It is cost-effective and can be disposable and menstrual cups are recommended for a single user. There are no adverse effects on the vaginal flora, which is the key benefit of menstrual cups but some women have reported vaginal wounds or severe pain, rashes or allergies, and onset of urinary tract infection. Leakage of menstrual blood and uncomfortable wearing are the major limitations. Safety concerns related to these cups include adverse occurrences, such as infections, effect on vaginal microflora, vaginal abrasion, toxic shock syndrome, infections in the reproductive or urinary or digestive tract and safety in cheap or poor absorbent material conditions (Van Eijk *et al.*, 2019).

4. Disease associated with improper use of sanitary pads

Menstruation hygiene practices are of serious issue which has a health impact, if it is neglected and may cause reproductive tract infection (RTI), toxic shock syndrome and other vaginal diseases. The adolescent's health is negatively affected or damaged by poor genital

hygiene. Mostly the girls are unprepared and unaware of menarche because they are wrongly informed and not informed about menstruation. If menstruation hygiene is not safely handled or practiced, it may lead to an unhealthy life and the consequences will be distress, genitourinary tract infection, reproductive tract infection, cervical cancer, guiltiness, odor problem, school dropout, etc.

4.1 Menstrual toxic shock syndrome (mTTS)

The mTTS risk was higher in adolescent women who utilize tampons compared to those who utilize menstrual pads. The risk of mTTS is increased together with the increased absorbency of the tampon. As a consequence of persuasive epidemiology in the market, the penetrable tampons were abolished or removed. The risk of mTTS is increased when the tampon is used for a longer period of time. The symptoms of mTTS are observed near or during menstruation which is similar to symptoms of early flu, including dizziness upon standing, diarrhea and vomiting, and acute onset of fever (Schlievert, 2020).

4.2 Reproductive tract infection (RTI)

Menstrual hygiene management (MHM) can be affected by water, sanitation and hygiene (WASH) resources at household, the access and quality of cleansing material, and there will be significant variation of these resources within or between the countries. These MHM practices can be inconvenient and unhygienic, which may cause different reproductive tract infections and psychosocial stress. RTIs are common and are a major public health concern. The common reproductive tract infections are vulvo-vaginal candidiasis (VVC), bacterial vaginosis (BV) and trichomonas vaginalis (TV). The most common is BV. The BV is characterized by variation in the vaginal microbiome with a decrease in lactobacillus colonization and excess growth of facultative anaerobic bacteria. The vaginal inflammation is absent in BV which is the most dangerous characteristic for women of reproductive age due to its harmful pregnancy outcomes like development of pelvic inflammatory disease, preterm birth, and acquisition of sexually transmitted infections. Another most common RTI is candida infection and 75% of adolescent women are affected by VVC at least once in their lifetime. VVC is asymptomatic and thus mentioned as colonization. The most prevalent sexually transmitted infection is TV infection. TV can cause reproductive complications like pregnancy loss, tubal factor infertility, premature membrane rupture, low birth weight, pelvic inflammatory disease and preterm birth (Torondel *et al.*, 2018).

4.3 Polycystic ovary syndrome

Polycystic ovary syndrome (PCOS) affects about one in 15 women worldwide. It is a heterogeneous endocrine disorder. The significant endocrine disruption is adverse androgen activity or secretion, and also the insulin activity is abnormal in most women. PCOS causes many health complications, including hirsutism, menstrual dysfunction, acne, metabolic syndrome, obesity and infertility. The women affected by this disorder may experience the risk of developing diabetes (type 2) and cardiovascular disease. The diagnosis of PCOS is chronic anovulation, hyperandrogenism, and after removal of polycystic ovaries condition may improve or remain the same whose cause is unknown (Norman, Dewailly, Legro, & Hickey, 2007).

4.4 Common types of menstrual irregularities

4.4.1 Amenorrhoea. The absence of menarche, in girls who never menstruated until the age of 16 years or the absence of menstruation for more than 3 months, is termed amenorrhoea. Women with this type of irregular menstruation which develop after discontinuing oral contraceptive are commonly referred to as post-pill amenorrhoea. During lactation, pregnancy,

for prepubertal girls and the menopause period, the absence of menstruation is common and physiological (Somwanshi, 2017).

4.4.2 *Dysmenorrhea (painful menstrual periods)*. Painful menstruation is rare, although, many women experience pain or discomfort during periods at the time of their reproductive life. Dysmenorrhea is classified into two groups:

- (1) Dysmenorrhea without pelvic disease
- (2) Dysmenorrhea due to pelvic disease

4.4.3 *Menorrhagia (heavy menstrual periods)*. Heavy menstrual bleeding is known as menorrhagia; 20% of the women experience this menorrhagia. Your menstruation is considered menorrhagia if:

- (1) Bleeding lasts for more than seven days.
- (2) Daily activities get affected due to bleeding.
- (3) Need double protection (a pad and tampon).
- (4) Every two to three hours your pad or tampon needs to be changed.

You may feel nauseated and tired, moody or depressed, severe cramps and headaches during heavy menstruation (Somwanshi, 2017).

4.4.4 *Oligomenorrhea*. It is occasional or infrequent and shows very light menstruation. This type of menstruation occurs at greater intervals of more than 35 days, in a year only 4–9 periods will occur. An oligomenorrhea is a menstrual cycle that occurs infrequently (or even very lightly at times). It is characterized by irregular menstrual cycles with more than 35 days between periods and fewer than nine cycles per year. Also, before the growth of irregular flow, the menstrual periods should be quickly recognized. The adenomas (prolactinomas) and thyrotoxicosis may cause oligomenorrhea.

4.4.5 *Polymenorrhea*. If the menstrual cycle duration is less than 21 days, then the periods will be more in number compared to the normal number per year. The number of periods you have per year will be higher if your menstrual cycle is shorter than 21 days. When menstruation occurs too regularly within 21 days, it is called polymenorrhea. The meaning of poly is many; therefore per year, there will be many cycles. Typically, every 17–21 days, the girl will have periods versus every 30 to 40 days. Therefore, there will be quick intervals and frequent, many periods. Flow can be moderate to scanty to heavy (Somwanshi, 2017).

4.4.6 *Abnormal uterine bleeding*. Any changes like the repetition of blood loss, change in uniformity and extension of blood flow in the menstrual cycle cause abnormal uterine bleeding (AUB), and nearly 25–30% of young women suffer from AUB. AUB is caused because of hormonal problems like polycystic ovarian disease, thyroid dysfunction and high prolactin concentration in the blood. AUB is classified into two groups: acute abnormal uterine bleeding and chronic abnormal uterine bleeding. Utilizing high-dose estrogen can help in the management of the acute AUB, whereas it is difficult to treat chronic AUB (Marnach & Laughlin-Tommaso, 2019).

If menstrual bleeding is more than seven days, the pad takes 1–2 hours to be immersed with blood, more than 80 ml of blood loss is there and more than one inch of clot size is released, then it is known as abnormal uterine bleeding or heavy menstrual bleeding (HMB). During the loss of blood in menstruation, the anemia in young women is high. If bleeding affects or disturbs your normal activities, then it is considered to be heavy. In normal periods the blood loss is about 5 tablespoons, but in abnormal uterine bleeding, the blood loss will be more than 10–25 times each month. Every hour you have to change the pad instead of 3–4 times a day. At various stages of menstruation—during menarche, when you begin

menstruating, and during menopause—you may experience heavy bleeding. Women having abnormal uterine bleeding can blame their condition of hormones. The body produces more or less reproductive hormones (estrogen or progesterone), which are important to maintain the regular menstrual cycle. For example, ovulation will not occur regularly in women with heavy bleeding. Ovulation is a process where ovaries release an egg; in a normal menstrual cycle, it occurs at day 14, and changes in the hormone level help to trigger ovulation.

4.4.7 Premenstrual syndrome (PMS). Premenstrual syndrome (PMS) includes psychological and physical symptoms connected with the menstrual cycle; 40% of women experience symptoms of PMS, and it is severe enough to affect daily life. The common symptom of PMS is depression; it may also include painful breasts, anger, fatigue, anxiety, bloating, mood swings, headache and crying. There are hundred possible symptoms. Girls with this syndrome may experience these symptoms a week before their periods and it disappears when periods begin (Chung *et al.*, 2014).

4.4.8 Premenstrual dysphoric disorder (PMDD). Premenstrual dysphoric disorder (PMDD) is an extreme level of PMS, which significantly disturbs a woman's life. The common symptoms are anxiety, heightened irritability and mood swings (Yonkers & Simoni, 2018). The symptoms of premenstrual dysphoric disorder continue for 5–7 days before menstruation begins and gets relieved when periods begin (Chung *et al.*, 2014).

4.4.9 Urinary tract infections. Urogenital infections like urinary tract infections and bacterial vaginosis (BV) are caused due to unhygienic MHM practices. UTI cases are increased because of poor awareness about MHM practices (Das *et al.*, 2015). Utilization of sanitary pads for more than 4 hours or utilizing dirty and damp menstrual clothes will act as a suitable environment for the multiplication and growth of harmful yeast and bacteria. Prolonged utilization of sanitary pads or unhygienic absorbent provides a suitable environment for the growth of microbes like *E. coli*, *Candida albicans*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. These bacteria will affect the urinary tract including the urinary bladder and urethra, creating painful urination, back pain, fever and lower abdominal pain. These difficulties can be avoided by utilizing clean and sun-dried clothes or hygienic absorbents. Cleaning external genitalia with gentle soap and clean water with regular changes of hygienic absorbent will prevent 97% of infections.

5. Nanotechnology-based female hygiene products

Nanotechnology has been playing an important role in different fields of biology and medicine including targeted drug delivery (Ghosh, Girigoswami, & Girigoswami, 2019; Girigoswami, Pallavi, & Girigoswami, 2020), imaging (Gowtham *et al.*, 2022; Jagannathan, 2022), biosensing (Akhtar, Metkar, Girigoswami, & Girigoswami, 2017; Girigoswami, Ramalakshmi, Akhtar, Metkar, & Girigoswami, 2019; Metkar & Girigoswami, 2019), theranostics (Agraharam, Saravanan, Girigoswami, & Girigoswami, 2022; Chatterjee *et al.*, 2023; Haribabu, Girigoswami, Girigoswami, & Nano-Objects, 2021; Pallavi *et al.*, 2022), nanoformulation of nutraceuticals (Balasubramanian, Girigoswami, & Girigoswami, 2022, 2023), etc. Among them, silver and gold have shown their special applications in many cosmetic and skin care products including the role of silver in improving female hygiene products, such as sanitary towels and panty liners (Ahmadi, 2020; Sakthi Devi, Girigoswami, Siddharth, & Girigoswami, 2022; Salvioni *et al.*, 2021). There have been recent improvements in the amalgamation of natural products and nanostructures to yield effective coatings for female intimate hygiene products to relieve pain and other associated discomforts. Traditionally, cannabis plants have been cultivated and used for industrial and medicinal purposes, while more recently they have gained popularity for relieving menstrual pain. Cannabis contains over 80 cannabinoids, which are chemicals. Tetrahydrocannabinol (THC) is the most commonly used cannabinoid, while cannabidiol (CBD) is the second most

common. There is great potential in its use as an analgesic, antiepileptic, muscle relaxant, anxiolytic, neuroprotective and antipsychotic, as well as an anti-inflammatory. CBD has been embedded into liposomes using nano/microencapsulation as a potential coating for cellulose sanitary material using nano/microencapsulation. CBD can be released into the uterus through the slow-release mechanism when encapsulated in a liposome and placed/crosslinked on a tampon thereby alleviating uterus pain (Volmajer Valh *et al.*, 2020). Another breakthrough in the use of nanotechnology in sanitary pads highlights that the MEA Business Awards have named Pectiv the most innovative sanitary pad of the year 2021. In addition to providing refined products, the brand aims to address any problems that may arise during a menstrual cycle. The innovative sanitary pads provide protection from bacteria growth, as well as prevention of itching and bad odor (<https://pectiv.com/>).

6. Conclusion

Female hygiene has been a concern throughout the world due to very little research executed on this topic. There are many differences in female hygienic practices which vary from region to region as well as knowledge of the people. Due to improper hygiene maintenance during menstrual periods, and usage of unhygienic sanitary pads, several kinds of diseases are manifested in females which need to be addressed. With the development of science, especially nanotechnology a few products have come into the market that can relieve the symptoms of menstrual pain, bad odor, etching, etc. This mini review summarizes the proper female hygiene procedures, particularly during the menstruation period, the various kinds of diseases that may arise due to poor maintenance of female hygiene, and some developments that are taking place using scientific research to address these issues.

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Corresponding author

Koyeli Girigoswami can be contacted at: koyelig@gmail.com

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