


Research Article

Experimental and Computational Approaches for the Classification and Correlation of Temperament (*Mizaj*) and Uterine Dystemperament (*Su'-I-Mizaj Al-Rahim*) in Abnormal Vaginal Discharge (*Sayalan Al-Rahim*) Based on Clinical Analysis Using Support Vector Machine

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The temperament (*Mizaj*) of the body is an essential constituent for health conservancy and diagnosis of several diseases. Hence, general body temperament and uterine dystemperament (*Su'-i-Mizaj*) with abnormal vaginal discharge (*Salayan al-Rahim*) need evaluation. In addition, we also applied a computational intelligence technique for enhancing scientific validity to classify the warm-cold and wet-dry temperaments. This trial included a total of 66 participants with a vaginal discharge of reproductive age. Data included demographic characteristics of the participants, symptoms associated with vaginal discharge, women's general temperament, and symptoms of uterine dystemperament. Correlation between general body temperament and age, abnormal vaginal discharge, and its associated symptoms was also performed. Additionally, we used the Support Vector Machine-Radial Basis Function (SVM-RBF) model to classify the warm-cold and wet-dry temperaments. Warm general temperament was highly prevalent (77.27%), followed by moderate (19.69%) on the warm-cold temperament scale. In wet-dry temperament, moderate general body temperament (50%) was more prevalent. In warm-cold and wet-dry scores, 78.78% and 74.24% had warm and wet uterine dystemperament, respectively. The age and symptoms were correlated with general temperament. A strong positive correlation was found between warm general temperament and warm dystemperament of the uterus ($r=0.40$, $p<0.009$). In addition, our SVM-RBF CV-5 classification model achieved the highest accuracy (99.2%). Our results showed that vaginal discharge is more common in warm general temperament and warm-wet dystemperament of the uterus. The same has been proven by computational intelligence. Nevertheless, vaginal discharge can also happen in normal and other temperaments.

1. Introduction

As per the Unani concept, the body of a human is made up of four elements (*Arkan*) that influence each other and produce unique qualities, known as *Mizaj* (temperament). These elements and temperaments produced by them are responsible for the growth, nutrition, and metabolism of the organism [1]. The temperament concept is a basic modality of the Unani system of medicine, CAM, widely practised in the subcontinent of India and some other parts of the world. Temperament is one of the fundamental components in defining human health and disease. Hence, the *Mizaj* assessment is used as a tool to determine the physiopathology of disease, diagnosis, prevention of disease, and management in Unani medicine [1, 2]. An individual's temperament directly affects his state of health, and its disruption leads to an imbalance, called dystemperament (*Su'-i-Mizaj*), causing one or more type/s of illnesses [3]. An individual's temperament is maintained and preserved by humour (*Akhlat*) [2]. There are four types of temperaments, namely, warm, cold, wet, and dry, in Unani medicine [4], and they are related to four humours, namely, sanguine, phlegmatic, choleric, and melancholic [1, 2]. Each organ also has its specific temperament in addition to general body temperament [3, 5]. The most common cause of disease of an individual organ is dystemperament, which is represented by various symptoms of that individual organ. Numerous gynaecologic disorders are conceptually associated with the dystemperament of the uterus, including dysmenorrhoea, menstrual disorders, abnormal uterine bleeding (AUB), abnormal vaginal discharge, and infertility [4].

Vaginal discharge (VD) is the commonest complaint [6] and the common reason for which women seek medical attention [7] in their reproductive age group. It can be a normal physiologic variance or a pathological manifestation [6]. AVD is the second most common problem after menstrual disorder or AUB, and 1 in 10 women represents vaginal discharge in a year [8]. In the healthcare setting, approximately 11% to 38.4% of Indian women seek care for vaginal discharge [9]. A study disclosed that about 21% of Indian women are estimated to have any one type of reproductive tract infection/sexually transmitted infection at any given point in time [10]. Abnormal vaginal discharge (AVD) occurs frequently among women with candidiasis, trichomoniasis, bacterial vaginosis, gonorrhoea, and chlamydia [6].

Unani classical manuscripts elucidate the concept of vaginal discharge [11]. Avicenna [12] (980–1037 AD) opined that leucorrhoea (*Sayalan al-Mani*) is an excessive flow of normal discharge from the uterus and vaginal discharge (*Sayalan al-Rahim*) is an infected discharge pouring out from the uterus. Furthermore, he states that normal vaginal discharge is also noted at the time of sexual arousal; however, if the discharge is seen without sexual arousal, then the cause of the discharge is the weakness of the uterine digestive faculty (*Du'fe Quwwat-i-Hadima al-Rahim*). The various aetiological factors of abnormal vaginal discharge are the

dominance of humour (*Ghalaba-i-Akhlat*) causes, an imbalance in the four senses of humour leading to abnormal vaginal discharge, reproductive tract infection/metritis (*Waram al-Rahim*), vaginitis (*Waram al-Mahbil*), syphilis (*Aatshak*), gonorrhoea, and so on [11]. The pathological vaginal discharge may be white, yellow, red, or black [13].

Organ temperament is associated with the humour predominant in that organ, and any qualitative or quantitative change in humour leads to disease. Unani philosophers surmised that the human body is regulated by three major faculties/powers (*Quwa*). Natural faculty (*Quwa Tabiiyya*) is a specific faculty for metabolism, growth, and reproduction [14]. Disturbance of the power of the uterus may cause vaginal discharge. Uterine dystemperament (*Su'-i-Mizaj al-Rahim*) leads to weakness of nutritive faculty (*Du'fe Quwwat Ghadhiya*) that weakens digestive faculty (*Quwwat Hadima*) and uterine retentive faculty (*Quwwat-i-Masika al-Rahim*) [13].

Various studies have shown the relationship between some gynaecological diseases and temperament such as dysmenorrhoea [15], infertility, mixed urinary incontinence [16], and menopausal transition [17]. The principle of disease management in Unani medicine is to correct the changed temperament, as general temperament (*Mizaj Shakhsi*) or uterine dystemperament is considered an important cause of disease. Thus, the patient's general and/or organ temperament needs to be assessed before initiating the treatment. Furthermore, other traditional medicine studies also indicated that clinical practice with syndrome differentiation perhaps leads to the innovation and improvement of biomedical diagnoses [18]. To date, none of the studies has determined the association between the general temperament and dystemperament of the uterus in AVD, its associated symptoms, and gynaecological infections.

Additionally, computational intelligence plays a significant role in the medical field, such as localization, treatment, detection, and recommendation. Presently, some intelligence techniques such as deep learning machine learning and the Internet of Things (IoT) [19] with processing techniques such as text, image, signal, video, and audio processing are used in medical areas. Previously, physiological signals are used to detect sleep disorders [20–22]. The authors applied intelligence techniques for the analysis of experimental data related to oxidative stress and mRNA [23–25]. Ali et al. [26] designed an automatic system for the detection of Parkinson's disease based on the ensemble learning technique. Ukwuoma et al. [27] used different deep learning to classify and detect medical diseases. Lai's group used medical machine learning and deep learning techniques to automatically detect bruxism sleep disorder [28–31] and cardiac diseases [32]. However, we used the computational intelligence technique to classify the temperament in AVD data in this study.

Thus, the objective of this study was to determine and correlate the general body and dystemperament of the uterus in AVD and its associated symptoms. In addition, we also

applied computational intelligence for enhancing scientific validity to classify the warm-cold and wet-dry general temperament.

The main contributions of this study are as follows:

- (i) This study will provide the scientific basis for the traditional concept of the role of temperament in health and disease.
- (ii) This study will help clinicians to diagnose gynaecological disorders and to treat them accurately and easily by quantifying the temperament of organs and the patient's general temperament.
- (iii) This study will provide support to the clinician to select proper diet and Unani drugs as per temperament based on the general body or uterine temperament as the treatment modality is a heteropathy regimen as in Unani medicine, the basic principle of treatment is treatment contrasts with the nature and temperament of the disease or heteropathic regimen (*Ilaj-bil-Zid*).
- (iv) This study will design a heatmap based on a clinical experiment and classify warm and wet general body temperament and uterine dystemperament in AVD using the Support Vector Machine-Radial Basis Function (SVM-RBF) model.
- (v) This study may facilitate clinicians in their day-to-day diagnosis and treatment.

The proposed paper is organized in the standard format: Introduction, Materials and Methods, Result, Discussion, and Conclusion (Figure 1).

2. Materials and Methods

2.1. Study Design. A single-centre, retrospective study included a total of 66 participants with the AVD of reproductive age who fulfilled the inclusion criteria. The data were collected from March 2018 to November 2018. This study was conducted in the Department of Ilmul Qabalat wa Amraze Niswan (OBG), National Institute of Unani Medicine, Bengaluru, India.

2.2. Institutional Review Board and Ethical Consideration. The scientific and ethical committee approved the intramural research protocol with reference IEC No. NIUM/IEC/2019–20/IMR/02. This study was completed based on the Helsinki Declaration and the GCP guidelines, Ministry of Ayush, GOI. The study is registered with the Central Trial Registry of India with reference No. CTRI/2021/01/030553 (dated: 15/01/2021).

2.3. Informed Consent Statement. Written informed consent was obtained from each participant included in the study.

2.4. Participant's Description. Sixty-six were included of the 97 participants who were initially screened, and 31 were excluded because of various reasons (fibroid and ovarian cysts ($n = 10$), severe PID ($n = 11$), cervical cancer ($n = 1$),

lactation ($n = 3$), positive urine pregnancy test ($n = 2$), and intrauterine contraceptive device ($n = 4$)). Thus, 66 participants were included.

2.4.1. Eligibility Criteria. The inclusion criteria included married women aged 18–50 years who had a history of AVD or/and associated with symptoms such as dyspareunia, dysuria, burning micturition, vulvar itching, and vaginal malodour. The exclusion criteria were participants with any undiagnosed vaginal or uterine bleeding, ulceration, genital malignancies, pregnancy, and lactating women. Participants with any clinical manifestation of venereal disease were also excluded.

2.4.2. Procedure. Sociodemographics included information such as name, age, address, contact number, education, occupation, socioeconomic status as per the Kuppaswamy scale, and habitat. The detailed menstrual history of the age of onset of menarche, menstrual cycle pattern, last menstrual period (LMP), and associated symptoms was noted. Detailed obstetrical and contraceptive history was recorded. VAS score for the symptoms associated with AVD was also noted. Furthermore, severity grading of symptoms as none (0), mild (1–3), moderate (4–6), and severe (7–10) was also noted. Per speculum and vaginam examination findings recorded were noted and analysed. Furthermore, a validated questionnaire for general temperament and clinical features to assess the uterine dystemperament described in the Unani literature was retrieved. Specific investigation such as human immunodeficiency virus (HIV), hepatitis B surface antigen (HbsAg), Venereal Disease Research Laboratory (VDRL), Pap smear, vaginal wet mount, and pelvic ultrasonography was carried out to diagnose the cause of the vaginal discharge.

2.5. Assessment Tool

2.5.1. Validated Temperament Questionnaire. A well-validated questionnaire included 10 questions to assess the general temperament of the body based on the clinical features of the ten determinants mentioned by Avicenna. Cronbach's α coefficient was 0.71 for this questionnaire [33], and the reliability was 0.82 through the test-retest technique with Spearman-Brown correlation coefficient ($P < 0.05$) [34].

2.5.2. Dystemperament of the Uterus. The clinical features were scored on a rating scale of 2 through 1. The total score of each patient was added up, and the inferences for the dystemperament of the uterus were taken based on an equal-interval scale developed from the total score of the questionnaire. The reliability was 0.87 for split-half reliability for the questionnaire [17].

2.5.3. Sample Size. The sample size was calculated as 60 based on the scores of the scales. After including 10% dropout in total, the sample size was calculated as 66 shown in (1) [16]:

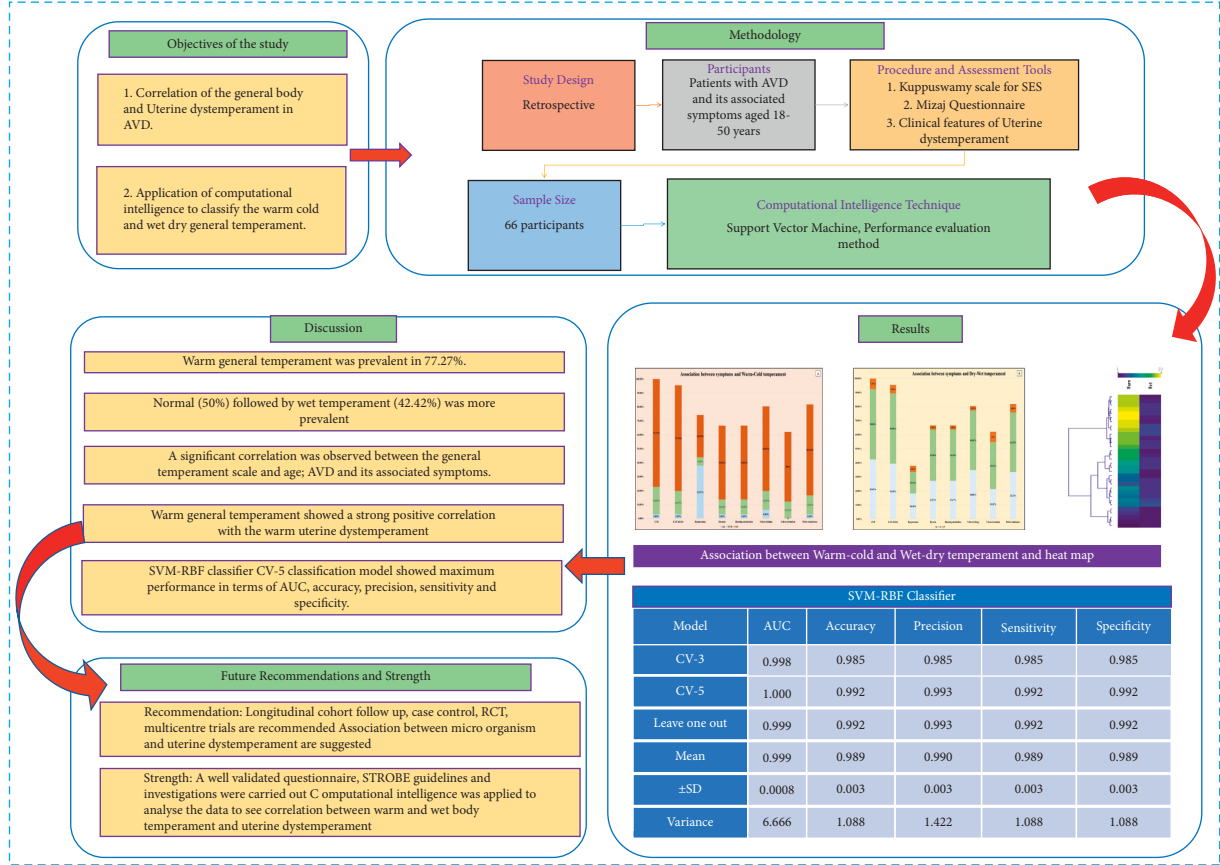


FIGURE 1: Schematic representation of the whole study.

$$\text{Sample size} = \left[\frac{\partial}{\mu_1 - \mu_2} \right]^2 = \left[\frac{6.0}{10 - 7.2} \right]^2 \times 15 = 60. \quad (1)$$

2.5.4. Statistical Methods. The data analysis was performed by the statistical software SPSS 28 version. The mean \pm SD and number (%) were imputed for continuous and categorical data measurements, respectively. The coefficient correlation was calculated to observe the association between age, abnormal vaginal discharge, associated symptoms, and temperament.

2.6. Computational Intelligence Technique

2.6.1. Support Vector Machine. One of the supervised machine learning techniques is the Support Vector Machine (SVM). It is utilized in the classification and regression methods of data analysis. For data prediction, an SVM creates a hyperplane in infinite-dimensional space. The hyperplane with the greatest distance to the nearest training point of the class achieves the maximum accuracy. SVM was initially established in 1963 by prominent scientists Alexey and Vladimir. After 29 years, Vapnik's team created SVM for nonlinear data using a kernel method to boost the hyperplanes' maximum margin [35]. We used SVM-Radial Basis

Function (SVM-RBF) kernel classifier in the present classification [36].

2.6.2. Performance Evaluation Method. General temperament and dystemperament of the uterus, warm-cold, and dry-wet temperament scores were analysed in terms of accuracy, sensitivity, precision, specificity, and Area Under the Curve (AUC). We used SVM-RBF with leave-one-out cross-validation (CV) 3- and 5-fold models. The warm and wet general body temperament and dystemperament of the uterus in AVD were analysed in terms of accuracy, sensitivity, precision, specificity, and area under the curve (AUC) [37–39], as shown in equations (2)–(5).

$$\text{Accuracy} = \left(\frac{TP + TN}{(TP + TN + FP + FN)} \right), \quad (2)$$

$$\text{Sensitivity} = \left(\frac{TP}{(FN + TP)} \right), \quad (3)$$

$$\text{Specificity} = \left(\frac{TN}{(FP + TN)} \right), \quad (4)$$

$$\text{precision} = \left(\frac{TP}{(TP + FP)} \right), \quad (5)$$

where TP is a true positive, FP is a false positive, TN is a true negative, and FN is a false negative.

3. Results

3.1. Demographic Variables. Participants with AVD were in the age group of 19 to 40 years, and the mean age was 29.61 ± 5.65 years. Out of 66 participants, 21.21% ($n = 24/66$) and 78.78% ($n = 52/66$) were Hindus and Muslims, respectively. The mean weight of the participants was 61.65 ± 14.02 kg. The mean height of the participants was 155.60 ± 5.14 cm. The mean BMI was 25.59 ± 5.54 kg/m². Two (3.03%) and 64 (96.96%) participants were from rural and urban areas, respectively (see Figure 2).

3.2. Socioeconomic Status. The highest number of participants was from the upper-middle class ($n = 29/66$, 43.93%), followed by the lower middle class ($n = 25/66$, 37.87%). Further details are summarized in Figure 3.

3.3. Menstrual and Obstetrics History. The menarche's mean age was 13.22 ± 0.87 years. The duration of the menstrual cycle was 27.91 ± 1.17 days, and the duration of flow was 3.90 ± 1.40 days. The past menstrual cycle was regular in 57 (86.36%) participants. Normal vaginal delivery (NVD) was noted in 51 (77.27%) participants. Further obstetrics details are summarized in Figure 4.

3.4. Clinical Examination Findings. Maximum participants had moderate ($n = 43/66$, 65.15%) and foul-smelling abnormal vaginal discharge ($n = 50/66$, 75.75%), and 57 (86.36%) participants had abnormal cervical findings (Figure 5).

3.5. Specific Investigations. Pap smear, vaginal wet mount, and pelvic ultrasonography were specific investigations carried out to diagnose the causes of vaginal discharge. Maximum participants had inflammatory Pap smear ($n = 44/66$, 66.66%) followed by bacterial vaginosis ($n = 13/66$, 19.69%). Amsel's criteria showed that the Whiff test and blue cells were positive in 17 (25.75%) participants. KOH test was positive in one (1.15%) patient. The normal saline test for trichomonas was negative in all participants. The vaginal pH was 4.56 ± 0.46 , and normal HIV, HbsAg, and VDRL were negative in all participants. Maximum participants (54.54%) had pus cells between 21 and 30/HPF. Maximum participants had pathological findings in ultrasonography ($n = 35/66$, 53.03%) (Figure 6).

3.6. Prevalence of Infections (Alone and/or Mixed Infections). Maximum participants had mixed infections ($n = 48/66$, 72.72%) (Table 1 and Figure 7).

3.7. Age, General Body Temperament, and Dystemperament of the Uterus. Participants with AVD had a high prevalence of warm ($n = 51/66$, 77.27%) in warm-cold and normal ($n = 33/$

66, 50%) in wet-dry general body temperament. Likewise, participants had a high prevalence of warm ($n = 52/66$, 78.78%) in warm-cold and wet ($n = 49/66$, 74.24%) in wet-dry uterine dystemperament. Warm ($n = 48/66$, 72.22%) in warm-cold and normal ($n = 30/66$, 45.45%) in wet-dry general temperament were more common between the age of 21–40 years (Table 2).

3.8. Distribution of Participants. Participants with abnormal vaginal discharge had a high prevalence of warm ($n = 51/66$, 77.27%) in warm-cold and normal ($n = 33/66$, 50%) in wet-dry general body temperament (Table 3). High prevalence of warm temperament in warm-cold and normal in wet-dry general body temperament was noted in participants with lower abdominal pain (75.75%, 50%), dyspareunia (30.30%, 15.15%), dysuria (53.03%, 36.36%), burning micturition (53.03%, 36.36%), vulval itching (60.60%, 42.42%), vulvar irritation (50%, 33.33%), and pelvic tenderness (65.65%, 42.42%) signs and symptoms (Table 3 and Figure 8). Table 4 summarizes the data according to the severity of symptoms and general body temperament.

3.9. Correlation between General Temperament and Age, Abnormal Vaginal Discharge, and Its Associated Symptoms

3.9.1. Warm-Cold Temperament. Between age 20–30 years and normal temperament, a very strong positive coefficient correlation ($r = 0.94$) was noted, followed by a moderate positive coefficient correlation ($r = 0.31$) between age 20–40 years and normal temperament, and a weak negative coefficient correlation ($r = -0.22$) between warm temperament and age 20–40 years was observed in the warm-cold temperament scale (Table 5).

3.9.2. Wet-Dry Temperament. A weak negative coefficient correlation ($r = -0.22$) between wet temperament age and 20–30 years was observed in the wet-dry temperament scale (Table 5).

3.9.3. AVD and Its Associated Symptoms. The correlations between AVD and its associated symptoms are summarized in Table 5. A strong negative correlation between vulvar irritation and normal general body temperament was noted in the warm-cold temperament scale ($r = -0.53$).

3.9.4. Correlation of General Temperament and Dystemperament of the Uterus. The warm general temperament had a strong positive correlation with warm dystemperament of the uterus ($r = 0.403$, $P < 0.009$).

3.10. Computational Result. Our SVM-Radial Basis Function (SVM-RBF) CV-5 classification model achieved maximum performance in terms of AUC (100%), accuracy (99.2%), precision (99.3%), sensitivity (99.2%), and specificity (99.2%). In addition, our SVM-RBF CV-3 classification

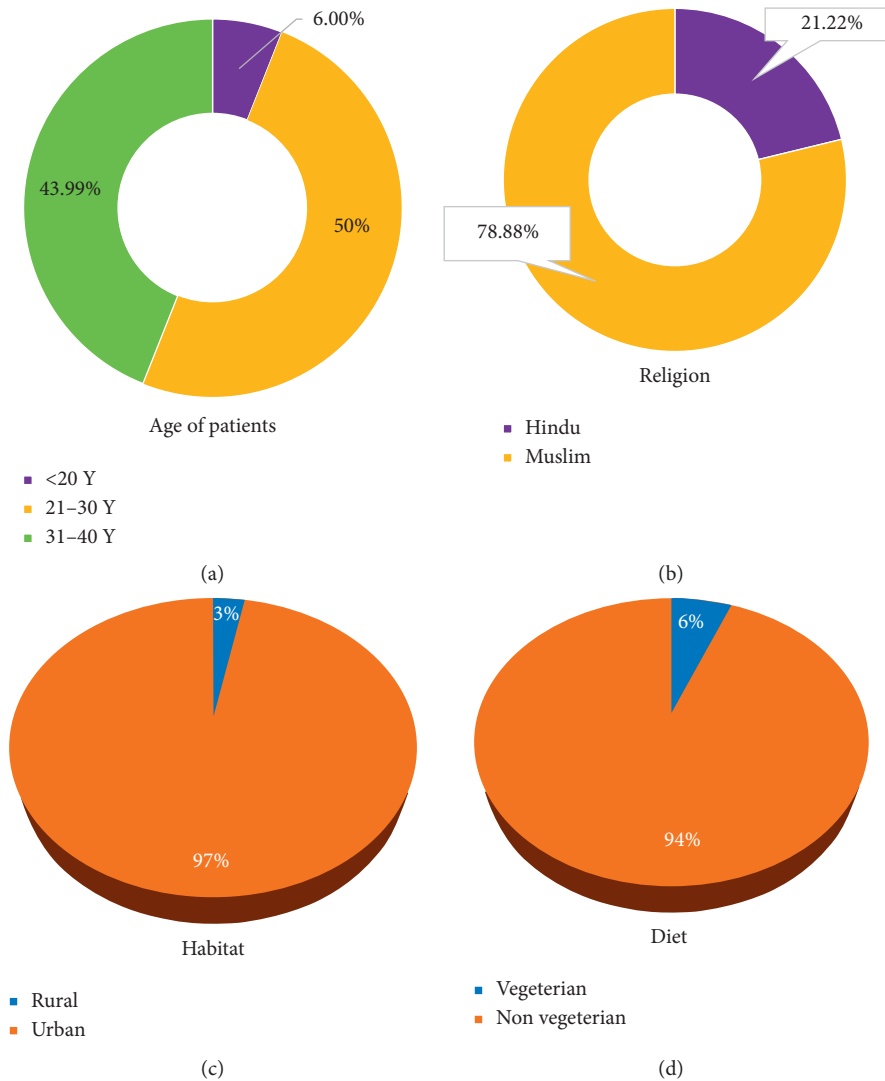


FIGURE 2: Demographic variables of patients with abnormal vaginal discharge. (a) Age of patients. (b) Religion. (c) Habitat. (d) Diet.

model has minimum performance in terms of AUC (99.8%), accuracy (98.5%), precision (98.5%), sensitivity (98.5%), and specificity (98.5%). However, our SVM-RBF CV-5 model is more suitable for the classification of warm and wet general body temperament and uterine dystemperament (Table 6). However, we also designed the heatmap for the relationship between general body temperament and uterine dystemperament in abnormal vaginal discharge mentioned in Figure 9.

4. Discussion

4.1. Major Findings. We explored the correlation between the general temperament and dystemperament of the uterus with age, AVD, and its associated symptoms. The data shows that warm general temperament was prevalent in 77.27% of participants with AVD. Normal (50%) followed by wet temperament (42.42%) was more prevalent in participants with AVD. A significant correlation was observed between the general temperament scale and age, AVD, and its

associated symptoms. Moreover, it was observed that the warm general temperament showed a strong positive correlation with the warm dystemperament of the uterus. In addition, SVM-RBF classifier CV-5 classification model showed maximum performance in terms of AUC (100%), accuracy (99.2%), precision (99.3%), sensitivity (99.2%), and specificity (99.2%).

4.2. Sociodemographic Characteristics, Gynaecological, and Obstetrical History. In this study, the majority of participants were urban ($n = 64/66$, 96.96%). Similarly, Mulu et al. [40] also reported that the majority of participants were urban. Educational levels showed that 75.75% of participants had higher and above education levels. The middle socioeconomic class was the highest prevalence of AVD, 81.81%, followed by the upper lower class (18.18%). This shows that AVD is more common in middle and low socioeconomic status people. Previous research has observed associations between socioeconomic status, disease prevalence, and mortality [41, 42]. A previous study found that low

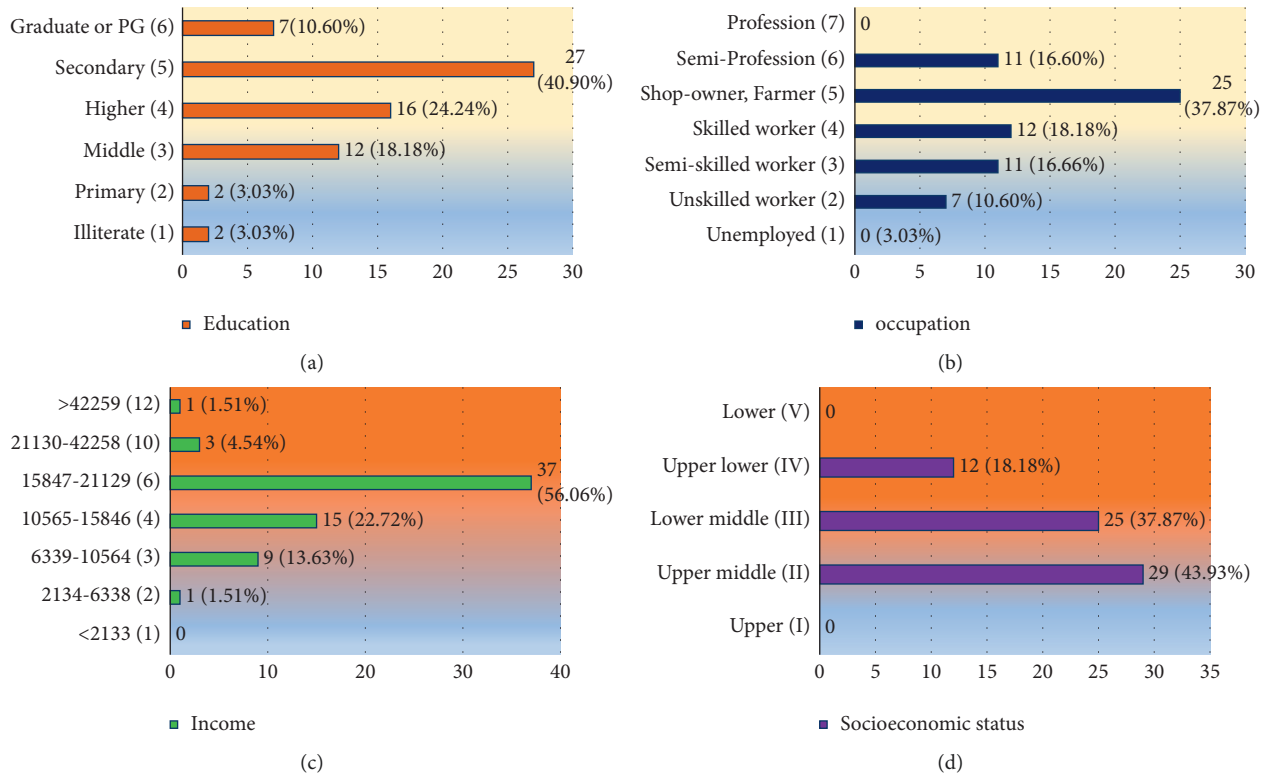


FIGURE 3: Socioeconomic status of patients with abnormal vaginal discharge. (a) Education. (b) Occupation. (c) Income. (d) Socioeconomic status.

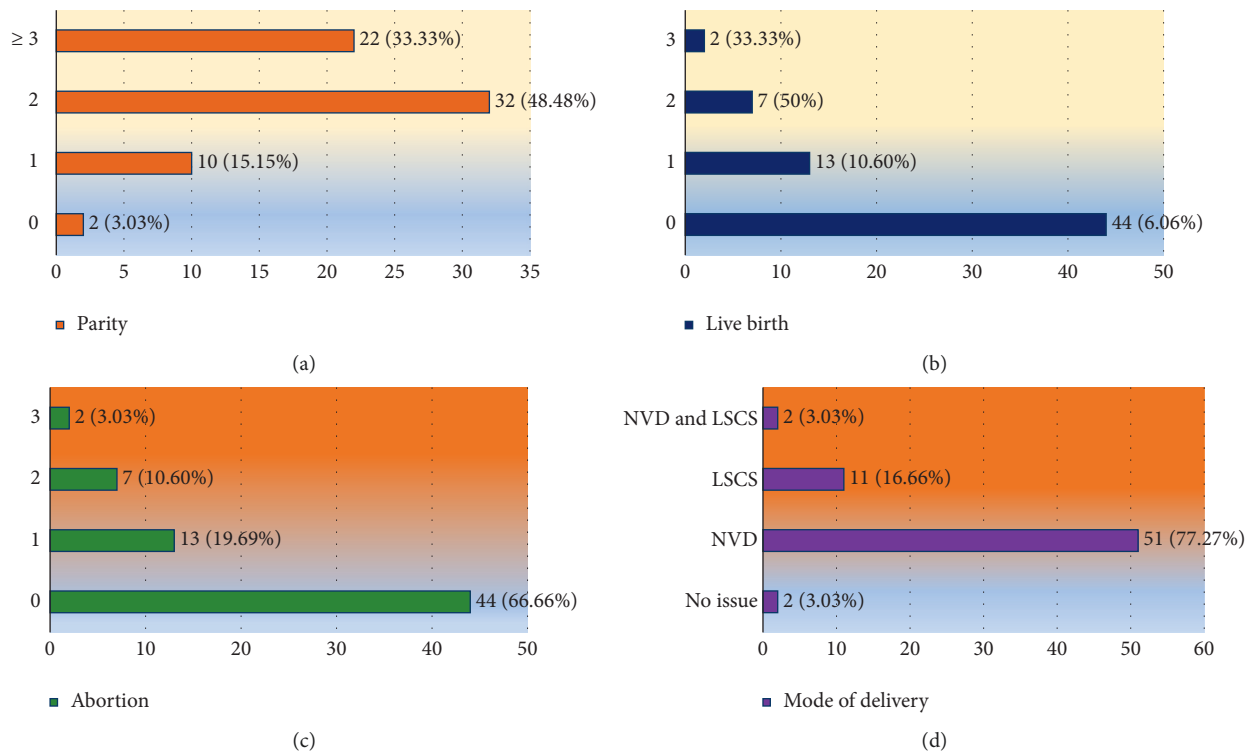


FIGURE 4: Obstetrics history of participants with abnormal vaginal discharge. (a) Parity. (b) Live birth. (c) Abortion. (d) Mode of delivery.

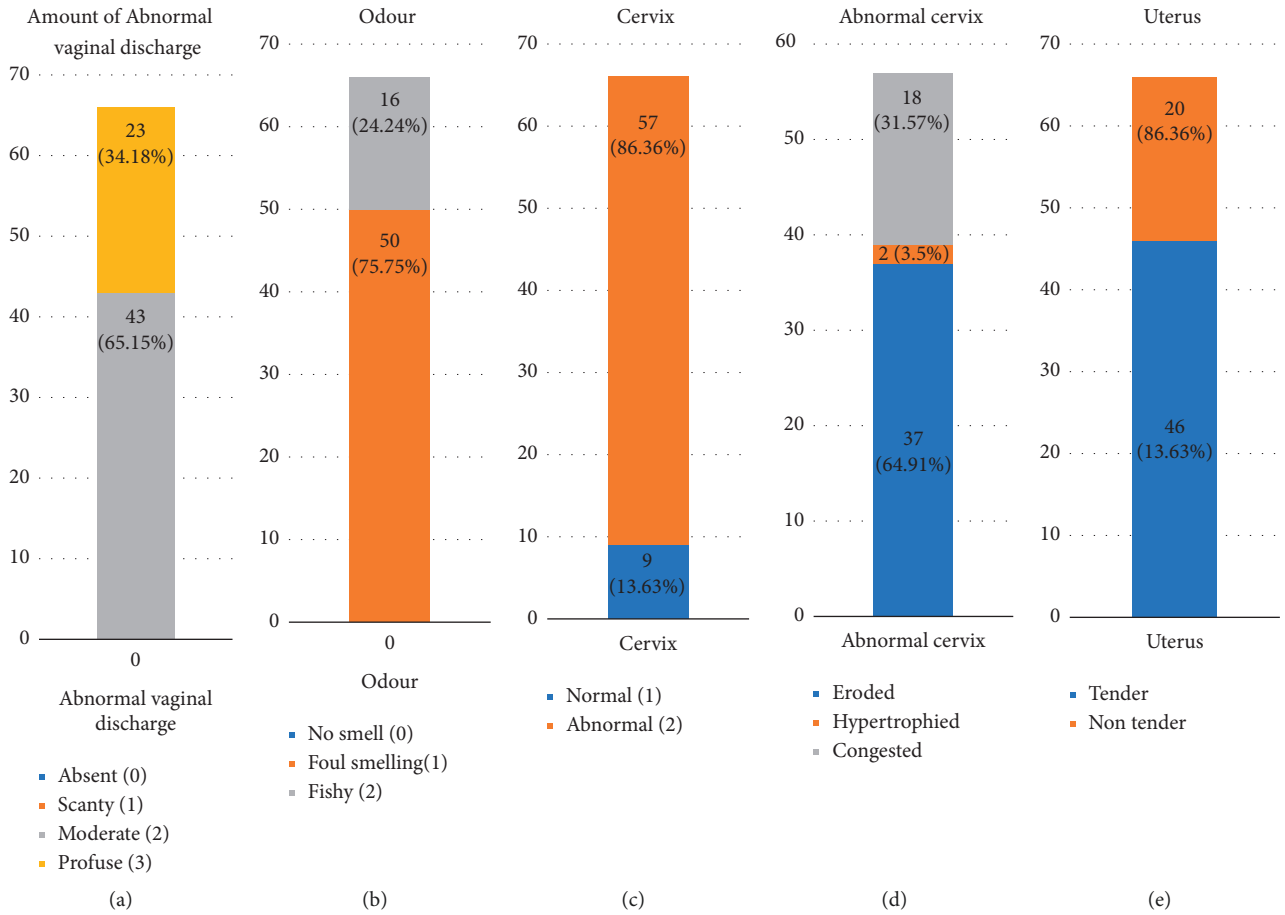


FIGURE 5: Clinical examination findings of participants with abnormal vaginal discharge. (a) Abnormal vaginal discharge. (b) Odour. (c) Cervix. (d) Abnormal cervix. (e) Uterus.

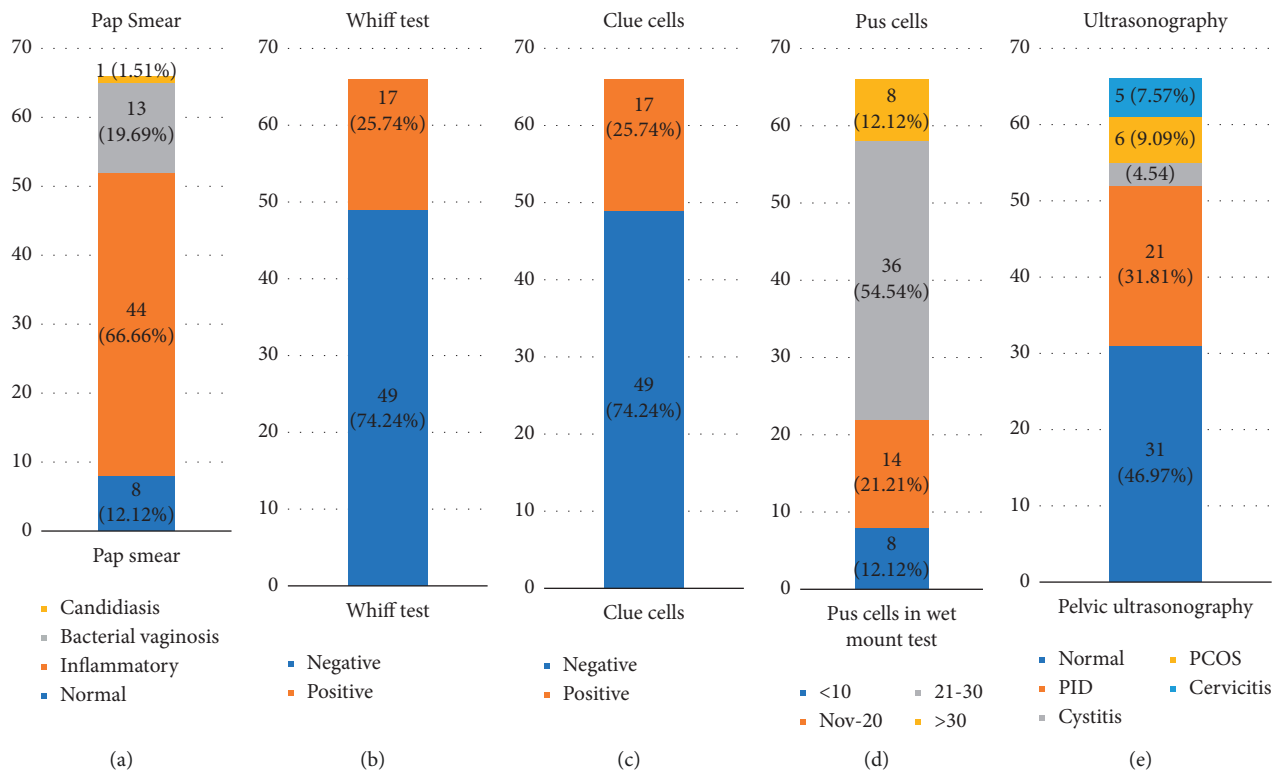


FIGURE 6: Specific investigations of participants with abnormal vaginal discharge. (a) Pap smear. (b) Whiff test. (c) Clue cells. (d) Pus cells. (e) Ultrasonography.

TABLE 1: Prevalence of infections alone and/or mixed infections.

Infections	No. of participants ($n = 66$)	%
Bacterial vaginosis	1	1.51
Cervicitis	5	7.57
Cervical ectopy	7	10.60
Total	13	27.27
Mixed infections		
PID + cervicitis	4	6.06
PID + CE	2	3.03
PID + BV	7	10.60
BV + CE	6	9.09
CE + cervicitis	21	31.81
Cervicitis + CE + PID	9	13.63
PID + BV + CE	3	4.54
Total	53	80.80

BV: bacterial vaginosis; CE: cervical ectopy; PID: pelvic inflammatory disease.

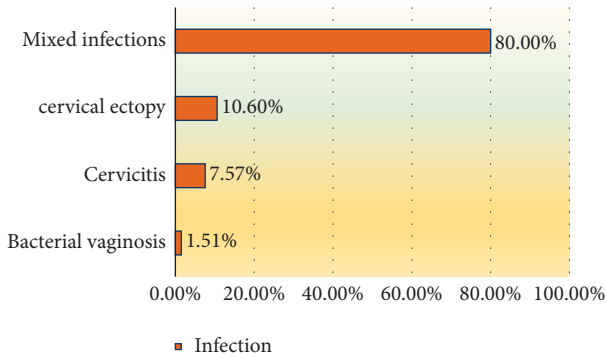


FIGURE 7: Prevalence of infection in participants with abnormal vaginal discharge.

TABLE 2: Age, general temperament (*Mizaj*), and dystemperament of the uterus (*Su'i-Mizaj al-Rahim*) in abnormal vaginal discharge.

Age (y)	Age and general temperament						Total ($n = 66$)	
	Warm-cold temperament							
	≤ 14 (cold)		15–18 (normal)		≥ 19 (warm)		No	%
≤ 20	0	0	1	1.15	3	4.54	4	6.06
21–30	0	0	6	9.09	27	40.90	33	50
31–40	2	3.03	6	9.09	21	31.81	29	43.93
Total	2	3.03	13	19.69	51	77.27	66	100
	Wet-dry temperament						Total	
	≤ 3 (wet)		4 (normal)		≥ 5 (dry)			
≤ 20	1	1.51	3	4.54	0	0	4	6.06
21–30	14	21.21	14	21.21	5	7.57	33	50
31–40	13	19.69	16	24.24	0	0	29	43.93
Total	28	42.42	33	50	5	7.57	66	100
	Age and dystemperament of the uterus							
Age	≥ 6 (warm)		< 6 (cold)		≥ 4 (wet)		< 4 (dry)	
≤ 20	3	4.54	1	1.51	3	4.54	1	1.51
21–30	23	34.84	10	15.14	24	36.36	9	13.63
31–40	26	39.39	3	4.54	22	33.33	7	10.60
Total	52	78.78	14	21.21	49	74.24	17	25.75

socioeconomic status, malnutrition, and unhygienic conditions may be accountable for AVD [43]. This study is similar to previous studies where abnormal vaginal discharge was common in low socioeconomic groups [44, 45]. The majority of participants were Muslim (78.78%). Similarly, a study conducted in Bangladesh also showed that the prevalence of AVD is more common in Muslims [45]. The age of menarche was 13.22 ± 0.87 years, and 81.81% had two or more two children, comparable to the previous study. Besides, 93.33% of the participants had experienced childbirth [46].

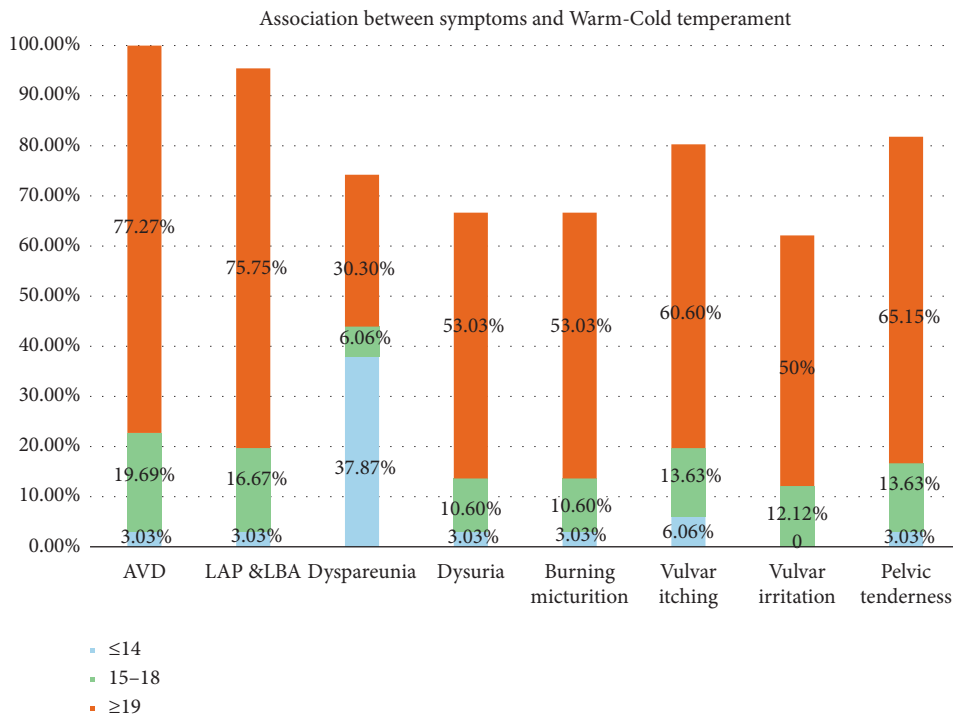
4.3. *General Temperament.* We found that 57.5% and 42.42% had warm and wet temperaments, respectively. Unani philosophers inferred that not only does warm-wet temperament cause AVD but also occasionally dry, warm, or normal or warm-dry temperament may also cause AVD. Furthermore, AVD may occur because of an abnormality in the quantity and quality of matter in the dystemperament. Cold, dry, warm or warm-dry, and dystemperament (simple or compound) cause derangement of expulsive faculty [12–14]. A previous study also reported that AVD was predominant in warm humour (*Khilt Harr*) participants [47].

4.4. *General Temperament and Age.* The mean age was 29.61 ± 5.65 years, similar to the previous studies [48]. Khan [13] observed that AVD was more prevalent in reproductive age due to the predominance of warm dystemperament of the uterus (*Su'i-Mizaj al-Rahim Harr*) or warm humour in the body at reproductive age. However, he also surmised that dominance of all humour causes AVD. This study observed that AVD was more prevalent in warm-normal/wet temperament participants. In addition, a few participants also had cold-dry temperaments. Bhat and Begum found that AVD is more prevalent in women aged 25–35 years [47], and similarly, another study observed that the active reproductive age group is more predisposed to AVD [49]. We found the highest prevalence of AVD in the age group of 21–30 years ($n = 33/66$, 50%), followed by 31–40 years ($n = 29/66$, 43.93%). Our study reported the highest prevalence of warm (72.71%) and normal/wet general temperament (45.45%) above 21 years of age. Furthermore, a very strong positive coefficient (0.94) between age 21–30 years and normal temperament was noted. This shows that as age increases, the warmth decreases, and at a young age, the temperament is warm. Unani physicians describe that the human life period is divisible into four age groups. Each age group may have its specific temperament; namely, temperament in growing age (*Sinn -i-Namu-21–30* years) is warm-wet temperament as in this period of growth, both innate humour (*Rutubat-i-Ghariziyya*) and innate heat (*Hararat-i-Ghariziyya*) are dominant. Adulthood (*Sin-i-Shabab*) ranges from thirty to forty (30–40 years) years and possesses a normal temperament [47, 50]. In this period, the quantity of innate humour is equal to the quantity required for the preservation of innate heat, neither excessive nor deficient, and maintains the continuance of normal

TABLE 3: Abnormal vaginal discharge, its associated symptoms, and general temperament.

VAS score for symptoms	No. of participants (n = 66)	General body temperament					
		Warm-cold			Wet-dry		
		≤14 (cold)	15–18 (normal)	≥19 (warm)	≤3 (wet)	4 (normal)	≥5 (dry)
AVD	6.30 ± 0.65						
Absent	0	0	0	0	0	0	0
Present	66 (100)	2 (3.03)	13 (19.69)	51 (77.27)	28 (42.42)	33 (50)	5 (7.57)
LAP and LBA	4.92 ± 1.50						
Absent	3 (4.54)	0	2 (3.03)	1 (1.51)	2 (3.03)	0	1 (1.51)
Present	63 (95.45)	2 (3.03)	11 (16.67)	50 (75.75)	26 (39.39)	33 (50)	4 (6.06)
Dyspareunia	1.65 ± 2.31 41 (62.12)						
Absent	41 (62.12)	1 (1.51)	9 (13.63)	31 (46.97)	16 (24.24)	23 (34.84)	2 (3.03)
Present	25 (37.87)	1 (1.51)	4 (6.06)	20 (30.30)	12 (18.18)	10 (15.15)	3 (4.54)
Dysuria	1.77 ± 2.41						
Absent	40 (60.60)	0	6 (9.09)	16 (24.24)	10 (15.15)	8 (12.12)	4 (6.06)
Present	26 (39.39)	2 (3.03)	7 (10.60)	35 (53.03)	18 (27.27)	24 (36.36)	2 (3.03)
Burning micturition	3.24 ± 2.46						
Absent	22 (33.33)	0	6 (9.09)	16 (24.24)	10 (15.15)	8 (12.12)	4 (6.06)
Present	44 (66.67)	2 (3.03)	7 (10.60)	35 (53.03)	18 (27.27)	24 (36.36)	2 (3.03)
Vulvar itching	4.27 ± 2.31						
Absent	13 (19.69)	0	4 (6.06)	9 (13.63)	5 (7.57)	5 (7.57)	3 (4.54)
Present	53 (80.30)	4 (6.06)	9 (13.63)	40 (60.60)	23 (34.84)	28 (42.42)	2 (3.03)
Vulvar irritation	3.09 ± 2.62						
Absent	25 (37.87)	2 (3.03)	5 (7.57)	18 (27.27)	14 (21.21)	9 (13.63)	2 (3.03)
Present	41 (62.12)	0	8 (12.12)	33 (50)	14 (21.21)	22 (33.33)	5 (7.57)
McPS (pelvic tenderness)	2.27 ± 1.39						
Absent	12 (18.18)	0	4 (6.06)	8 (12.12)	6 (9.09)	5 (7.57)	1 (1.51)
Present	54 (81.81)	2 (3.03)	9 (13.63)	43 (65.15)	22 (33.33)	28 (42.42)	4 (6.06)

Data presented: no. (%) or mean ± SD; AVD: abnormal vaginal discharge; LAP: lower abdominal pain; LBA: low backache; McPS: modified McCormack pain scale for abdominopelvic tenderness; VAS: Visual Analogue Scale.



(a)

FIGURE 8: Continued.

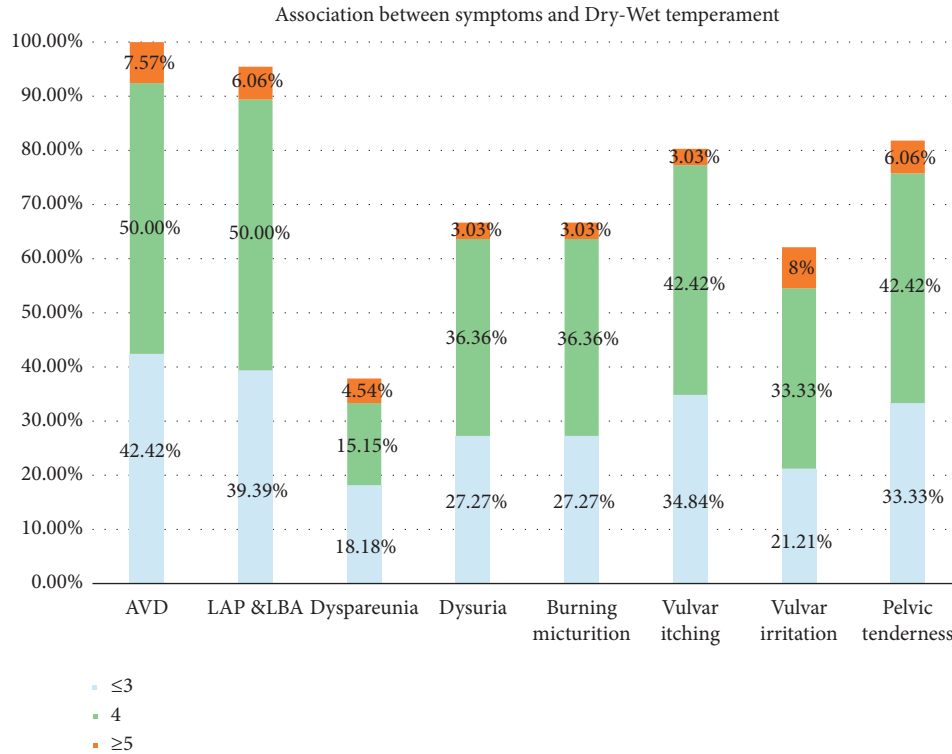


FIGURE 8: Association between symptoms with temperament. (a) Warm-cold and (b) dry-wet temperament.

metabolism. In this period, neither any growth nor any dissolution or degeneration occurs in the organs. Thus, the temperament of this period is normal. Usually, sanguine and bilious diseases are most common in this period. We also observed that AVD participants had warm (40.90%) and wet (21.21%) general body temperaments between the age of 21–30 years. A previous study also reported that AVD was predominant in warm temperament participants [47].

4.5. General Temperament, Abnormal Vaginal Discharge, and Associated Symptoms. In our study, AVD was associated with other gynaecological complaints such that 95.95% had lower abdominal pain (LAP) and backache (LBA), 37.87% had dyspareunia, 39.39% had dysuria, 66.67% had burning micturition, 80.30% had vulvar itching, and 62.12% had vulvar irritation. A previous study reported that all participants who had abnormal vaginal discharge also had associated symptoms [47]. Another study also reported that vaginal discharge was associated with pruritus, pain in the lower abdomen (84.1%), backache (72.96%), and burning micturition (66.7%). The majority of participants reported foul smell (75.75%) [44] discharge in our study, and a similar previous study also reported foul smell discharge in 60.4% of women. One more study also reported vaginal discharge associated with other clinical features [48]. Unani philosophers opined that AVD is associated with other gynaecological complaints such as pruritus, vulvae, low backache, increased frequency of urine, heaviness in the lower abdomen, lethargy, generalized weakness, giddiness,

dysmenorrhoea, constipation, burning sensation in extremities, cramps in lower limbs, and irritable mood. Furthermore, they also stated that sometimes it is also noted during pregnancy, which is copious and associated with severe itching [12, 13].

The commonest symptoms associated with AVD were LBA and abdominal pain in the present study. Various studies demonstrated the positive association between temperament and pain profiles in many diseases. Knaster et al. [51] showed that, in participants with chronic pain, temperament evaluation could improve the professionals' understanding of pain and behavioural experience. The traditional medicine texts review proposes that temperament correction can affect psychological and physical symptoms [15].

4.6. Dystemperament of the Uterus. Warm-wet uterine dystemperament prevalence was the highest (78.78%–74.74%) in AVD participants. Dystemperament of the uterus holds significant importance in uterine diseases; hence diagnosis and treatment depend upon the determination of individual and organ temperament [4]. A study found dry dystemperament of the uterus in all menopausal transition participants [17]. We found a significant correlation between general temperament and warm uterine dystemperament in AVD. As per the literature, warm dystemperament diseases are more common in reproductive age. In addition, the dystemperament of the uterus could also diffuse to the entire body and cause the body's dystemperament [52]. In our study, AVD

TABLE 4: Severity of symptoms and general temperament.

Severity grading of symptoms	General temperament						Total (n = 66)
	Warm and cold			Wet and dry			
	≤14	15–18	≥19	≤3	4	≥5	
AVD							
None	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mild	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Moderate	2 (3.03)	9 (13.63)	36 (54.54)	20 (30.30)	24 (36.36)	3 (4.54)	47 (66.66)
Severe	0	4 (6.06)	15 (22.72)	8 (12.12)	9 (13.63)	2 (3.03)	19 (33.33)
LBA and LAP							
None	0	2 (3.03)	1 (1.15)	2 (3.03)	0	1 (1.51)	3 (4.54)
Mild	0	1 (1.51)	2 (3.03)	2 (3.03)	1 (1.51)	0	3 (4.54)
Moderate	2 (3.03)	10 (15.15)	43 (65.15)	23 (34.84)	29 (43.93)	3 (4.54)	55 (83.33)
Severe	0	0	5 (7.57)	1 (1.51)	3 (4.54)	1 (1.51)	5 (7.57)
Dyspareunia							
None	1 (1.51)	9 (13.63)	31 (46.96)	16 (24.24)	23 (34.84)	2 (3.03)	41 (62.12)
Mild	0	0	8 (12.12)	4 (6.06)	4 (6.04)	0	8 (12.12)
Moderate	0	4 (6.06)	11 (16.66)	8 (12.12)	6 (9.09)	2 (3.03)	16 (24.24)
Severe	1 (1.51)	0	1 (1.51)	0	0	1 (1.15)	1 (1.51)
Dysuria							
None	1 (1.51)	8 (12.12)	31 (46.96)	16 (24.24)	20 (30.30)	4 (6.06)	40 (60.60)
Mild	1 (1.51)	0	7 (10.60)	1 (1.51)	7 (10.60)	0	8 (12.12)
Moderate	0	5 (7.57)	13 (19.69)	11 (16.66)	6 (9.09)	1 (1.51)	18 (27.27)
Severe	0	0	0	0	0	0	0 (0)
Burning micturition							
None	0	6 (9.09)	16 (24.24)	10 (15.15)	8 (12.12)	4 (6.06)	22 (33.33)
Mild	0	1 (1.51)	4 (6.06)	0	4 (6.06)	1 (1.51)	5 (7.57)
Moderate	2 (3.03)	5 (7.57)	31 (46.96)	18 (27.27)	19 (28.78)	1 (1.51)	38 (57.57)
Severe	0	1 (1.51)	0	0	1 (1.51)	0	1 (1.51)
Vulvar itching							
None	0	4 (6.06)	9 (13.63)	5 (7.57)	5 (7.57)	3 (4.54)	13 (19.69)
Mild	0	1 (1.51)	2 (3.03)	0	3 (4.54)	0	3 (4.54)
Moderate	2 (3.03)	8 (12.12)	38 (57.57)	22 (33.33)	24 (36.36)	2 (3.03)	48 (72.72)
Severe	2 (3.03)	0	0	1 (1.51)	1 (1.51)	0	2 (3.03)
Vulvar irritation							
None	2 (3.03)	5 (7.57)	18 (27.27)	14 (21.21)	9 (13.63)	2 (3.03)	25 (37.87)
Mild	0	1 (1.51)	4 (6.06)	2 (3.03)	3 (4.54)	0	5 (7.57)
Moderate	0	7 (10.60)	27 (40.90)	12 (18.18)	19 (28.78)	3 (4.54)	34 (51.51)
Severe	0	0	2 (3.03)	0	0	2 (3.03)	2 (3.03)

Data presented: no. (%); AVD: abnormal vaginal discharge; LAP: lower abdominal pain; LBA: low backache; McPS: modified McCormack pain scale for abdominopelvic tenderness; VAS: Visual Analogue Scale.

was prominent in warm and wet dystemperament of the uterus, and it was also observed in other temperaments. Similarly, Avicenna, a great Unani scholar, surmised that any type of uterine dystemperament may lead to abnormal vaginal discharge [12]. The study found an association between general and uterine temperament with some diseases of women. Another study showed that the majority of participants (73.7% in the case group and 26.3% in the control group) had a cold temperament with vaginitis [53].

It may be said that the dystemperament of the uterus of a person probably leads to genital tract infections, thereby causing AVD and its associated symptoms, which can be ameliorated by using appropriate therapeutic measures and amending temperament imbalance.

4.7. Future Recommendations, Limitations, and Strength. A longitudinal cohort follow-up study is recommended to evaluate the temperament relationship between genital tract

infection, aetiology, and abnormal vaginal discharge. It is also recommended to study the association between different microorganisms and the dystemperament of the uterus. If agreed with strong studies, the dystemperament of the uterus can be used as a measure for the prognostic criteria for female genital tract infection [54]. Furthermore, a case-control cohort and a randomized clinical trial are suggested to enhance the precision of the study. Furthermore, multicentre trials to see the variation in the population as per location and country for generalisability.

Regardless of such limitations, to date, to the best of our knowledge, this is the first study where we experienced significant associations between general and uterine temperament with age and associated clinical features of abnormal vaginal discharge. A well-validated temperament questionnaire for general temperament was used. Furthermore, the adaptation of STROBE guidelines was also a strength of the study. Amsel's criteria, ultrasonography, Pap smear, HIV, HbsAg, VDRL, and wet-mount vaginal smear

TABLE 5: Correlation between age, abnormal vaginal discharge, associated symptoms, and temperament.

Variables	General temperament								
	Warm-cold						Wet-dry		
	Normal temperament (15–18)			Warm temperament (≥19)			Wet temperament (≤3)		
	<i>r</i> value	95%CI lower	95%CI upper	<i>r</i> value	95%CI lower	95%CI upper	<i>r</i> value	95%CI lower	95%CI upper
Age									
20–30 (y)	0.94****	0.57	0.99	-0.12	-0.47	0.25	-0.22*	-0.68	0.36
31–40 (y)	-0.19	-0.86	0.73	0.005	-0.42	0.43	-0.05	-0.51	0.58
20–40 (y)	0.31**	-0.35	0.71	-0.22*	-0.46	0.03	0.03	-0.35	0.4
Clinical features: abnormal vaginal discharge and its associated symptoms									
AVD (<i>n</i> = 66)	0.28*	-0.31	0.72	-0.21*	-0.46	0.06	-0.05	-0.4	0.3
LAP and LBA (<i>n</i> = 63)	0.22*	-0.43	0.72	0.08	-0.19	0.35	-0.17	-0.5	0.24
Dyspareunia (<i>n</i> = 25)	0	0	0	0.04	-0.4	0.48	-0.15	-0.66	0.46
Dysuria (<i>n</i> = 26)	-0.25*	-0.92	0.8	0.13	-0.32	0.5	-0.30**	-0.74	0.3
BM (<i>n</i> = 44)	-0.07	-0.78	0.7	0.01	-0.32	0.34	-0.17	-0.58	0.30
Vulvar itching (<i>n</i> = 53)	-0.31**	-0.81	0.4	-0.08	-0.38	0.08	-0.10	-0.49	0.32
Vulvar irritation (<i>n</i> = 41)	-0.53 ***	-0.90	0.2	0.09	-0.25	0.42	0.13	-0.62	0.42
McPS (pelvic tenderness) (<i>n</i> = 54)	0.08	-0.61	0.7	-0.05	-0.35	0.24	-0.04	-0.45	0.3

Data presented: no. (%); mean ± SD; AVD: abnormal vaginal discharge; LAP: lower abdominal pain; LBA: low backache; McPS: modified McCormack pain scale for abdominopelvic tenderness; VAS: Visual Analogue Scale; BM: burning micturition; *r* value:**** ±0.70 or higher: very strong positive or negative relationship;**** ±0.40 to ±0.69: strong positive or negative relationship;** ±0.30 to ±0.39: moderate positive or negative relationship;* ± 0.20 to ± 0.29: weak positive or negative relationship; ±0.01 to ±0.19: no relationship.

TABLE 6: Performance of the warm and wet general body temperament and dystemperament of the uterus in AVD using Support Vector Machine- Radial Basis Function (SVM-RBF) classifier.

Model	AUC	Accuracy	Precision	Sensitivity	Specificity
CV-3	0.998	0.985	0.985	0.985	0.985
CV-5	1.000	0.992	0.993	0.992	0.992
Leave-one-out	0.999	0.992	0.993	0.992	0.992
Mean	0.999	0.989	0.990	0.989	0.989
±SD	0.0008	0.003	0.003	0.003	0.003
Variance	6.666	1.088	1.422	1.088	1.088

Bold means higher performance as compared to the others.

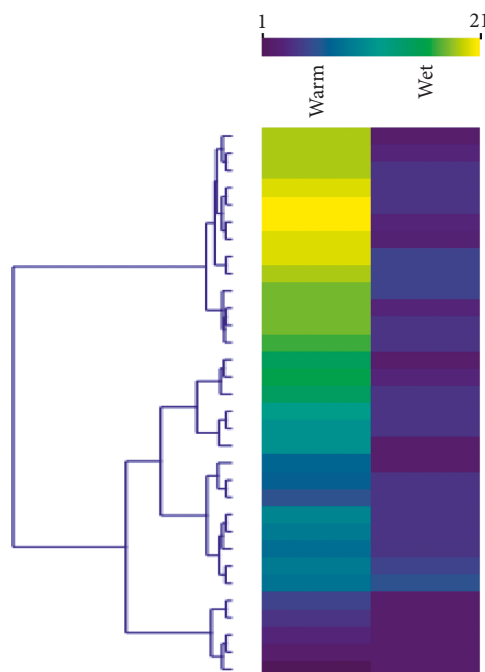


FIGURE 9: Heatmap for the relationship between general body temperament (wet and warm) and uterine dystemperament (wet and warm) in abnormal vaginal discharge.

were also performed to find the aetiological cause of the abnormal vaginal discharge. In addition, to enhance scientific validation, computational intelligence was applied to analyse the data to see the accuracy, precision, specificity, and sensitivity of the correlation between warm and wet body temperament and uterine dystemperament.

5. Conclusion

In the present study, 21–30 years was the most prevalent age group for AVD. Warm temperament in warm-cold general body temperament and normal or wet temperament were more predominant in wet-dry general body temperament in this disease. Warm-wet dystemperament of the uterus was more prevalent in AVD. Additionally, the warm general temperament was strongly associated with uterine warm temperament, while our SVM-RBF computational model is better for classifying the warm and wet conditions. This study may recommend innovative treatment methods and prevention in the field of female genital tract infections. However, it needs to be further evaluated.

Data Availability

The data used to support the findings of this study are available from the first authors upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Arshiya Sultana designed and planned the study, analysed the data, drafted, critically reviewed, and proofread the paper, and interpreted the data; Wajeeha Begum supervised the trial and proofread the paper; Rushda Saeedi was involved in carrying out the clinical trial and collating and interpreting the data; Khaleequr Rahman contributed to drafting, critically reviewing, and proofreading the paper; Md Belal Bin Heyat, Faijan Akhtar, Ngo Tung Son, and Hadaate Ullah designed the computational intelligence methodology, results, interpretation, and references. Arshiya Sultana, Md Belal Bin Heyat, and Faijan Akhtar contributed equally to this work.

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