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The Relationship of Perceived Immune Status, Psychological Distress, and Nutritional Status with Pathological Leukorrhea among Full-day School Students in Surabaya, Indonesia

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ABSTRACT

Background & aim: Leukorrhea is the most common disorder among female students in full-day senior high schools, and is often accompanied by distressing symptoms such as genital itching and a fish-like odor. The primary risk factors for this condition remain unclear. This study aimed to investigate the relationship between perceived immune status, psychological distress, and nutritional status with pathological leukorrhea among female students in a full-day school.

Methods: This study used a cross-sectional design with consecutive sampling of 131 female students at Muhammadiyah High School in Surabaya in January 2024. Students who experienced leukorrhea were characterized according to their immune status, level of psychological distress, and nutritional status. Data were collected using the Immune Status Questionnaire, the Depression, Anxiety, and Stress Scale-42, body mass index measurement, and the Vaginal Discharge Assessment form. The relationships were analyzed statistically using the chi-square and Fisher's exact tests.

Results: The majority (71%) of the respondents experienced pathological symptoms. Level of psychological stress and nutritional status did not show any association with symptoms of pathological leukorrhea (P= 0.977 and P=0.162, respectively), with an odds ratio and 95% confidence interval of 1.295 (1.011-1.659). However, low immune status was associated with symptoms of pathological leukorrhea (P=0.027). Most students with genital itching were immunocompromised.

Conclusion: Low immune status was identified as the primary risk factor for pathological leukorrhea among full-day school students. Students' immune status needs to be monitored and improved regularly to prevent pathological leukorrhea.

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Introduction

Global modernity has altered family behavior and environmental characteristics. Currently, both parents working in full-time jobs has become common (1). With this shift, parents are increasingly relying on support from their surroundings for parenting (2). Various alternatives are considered, including childcare and full-day schools. Full-day schools have gained popularity due to the expectations for enhanced education alongside parental responsibilities (3).

Full-day schools are a relatively recent phenomenon in Indonesia, emerging over the past decade (4). They have been widely adopted, from elementary to senior high grades, with students attending school from 6:30 AM to 4:00 PM, aligned with parental work schedules.

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Family gatherings are often limited to meal time in the evening (3).

The introduction of full-day schools has brought new challenges for students, particularly senior high school females (5). Leukorrhea is the most prevalent disorder among female students in full-day schools and is often accompanied by a fish-like odor, indicative of pathological leukorrhea (6). Parents and schools require support to address this issue.

Leukorrhea is influenced by various environmental factors such as temperature, humidity, and sun exposure duration. Full-day school presents a specific environment, characterized by low exposure of sunlight. Sunlight exposure is essential for vitamin D activation (2). Previous study revealed an association between vitamin D deficiency and itching grievance following leukorrhea (7).

There are a lot of factors that potentially contribute to the grievance following leukorrhea among full-day students. However, the primary risk factors among full-day school students remain unknown, complicating efforts to address this problem. This study aimed to investigate the relationship between perceived immune status, psychological distress, and nutritional status with pathological leukorrhea among female students in a full-day school.

Materials and Methods

This study was cross sectional designed. The study setting was Muhammadiyah High School (MHS), which is a popular full-day school choice for parents in Surabaya, offering a curriculum that emphasizes spiritual education. Students attend school five days per week, with weekends off. The study cohort comprised female students in the 10th and 11th grades.

The sample size was determined using the following equation: the proportion of female students with pathological leukorrhea (P1) was estimated to be 28% (based on a former study), whereas the proportion with non-pathological leukorrhea (P2) was estimated to be 52% (6). The minimum required sample size was calculated as 130 female students from the MHS.

The consecutive sampling was used to determine respondents. Students who were admitted with the parents' consent registered to follow the protocol. They were selected with suitable inclusion and exclusion criteria. Respondents were characterized as 15-16-year-old females' post-menarche who had experienced leukorrhea in the last month. Those who were married, sexually active, or were receiving hormonal treatment were excluded. Parents provided voluntary consent for respondents to follow all instructions during the study without coercion and to be able to stop or quit at any time without consequences. All procedures in this study were approved by the Medical Research Ethics Commission, Faculty of Medicine, Universitas Airlangga, as stated in the ethical clearance statement no. 8/EC/KEPK/FKUA/2024.

The respondents were characterized by their nutritional status, level of psychological stress, immune status, menstrual history, and symptoms of leukorrhea. Nutritional status, level of psychological stress, immune status, and menstrual history are the potential primary risk factors for pathological leukorrhea (7). Data were collected simultaneously using a cross-sectional design. Respondents completed questionnaires privately via closed online links and determined their nutritional status using direct measurement of body mass index. Status was categorized according to the World Health Organization (WHO) criteria: underweight (z score ≤ -2SD), normal (-2SD < z score ≤ +1SD), overweight (+1 SD < z score ≤ +2 SD), and obese (z score ≥ +2SD) (8).

The Depression Anxiety Stress Scale (DASS-42) was used to determine the level of psychological stress (the alpha Cronbach was 0.93). The subject was asked to answer 42 questions using a scale of frequency, with options of "never," "sometimes," "regularly," and "always." From a total of 42 questions, we used only 14 questions related to psychological stress. The total score of 14 questions was interpreted as the perceived stress status. Total scores of 0-14 indicate normal status, 15-18 indicate mild stress, 19-25 indicate moderate stress, 26-33 indicate severe stress, and +34 indicate extremely severe stress (9).

The Immune Status Questionnaire (ISQ) was used to determine the immune status (10-11). The subject was asked for disease experienced in the last 12 months with a scale of frequency in never, sometimes, regularly, often, and always. It was scored and interpreted according to the perceived immune status. A final ISQ score of ≤ 6 indicates low immune status (immunocompromised), whereas a score > 6 indicates high immune status (normal).

The symptoms of leukorrhea were determined using the Vaginal Discharge Assessment form (12-13). It contained menstrual cycle history, vaginal discharge history, and accompanying distressing symptoms. Menstrual history included data on the regularity and duration of menstrual days. The menstrual cycle was categorized as regular or irregular, and menstrual days up to seven days were considered normal, whereas more than seven days were categorized as prolonged menstrual days (menorrhagia) (12,13). Leukorrhea was categorized into pathological and non-pathological leukorrhea. All non-bloody vaginal discharges accompanied by at least one distressing symptom, such as itching, odor, abdominal pain, or colored discharge, were categorized as pathological leukorrhea, whereas physiological leukorrhea was not accompanied by distressing symptoms (13).

Data were collected by self-report. All questionnaires were recorded in the Google Form and reported as a master table. It was translated, cleaned, and coded into SPSS. Together with BMI, data were analyzed for statistical association.

Data were collected in a master table for analysis of distribution and associations using statistical methods. Chi-square and Fisher's exact tests were used to analyze statistical associations between risk factors for pathological leukorrhea among the participants. The significance level was set at $P<0.05$. The odds ratio (OR) was used to describe the risk of each factor for the development of pathological leukorrhea.

Results

A total of 137 female students voluntarily registered as respondents. Six were excluded because they had received hormonal treatment during the previous month. Consequently, 131 eligible female students participated in this study. All respondents experienced menarche between the ages of 9 and 15 years. Menstrual abnormalities, including irregularity and prolonged menstrual days (menorrhagia), were observed among the respondents. These characteristics are summarized in Table 1.

Table 1. Frequency distribution of characteristics of the respondents

Characteristics	Med (min-max)
Basic characteristics	
Age (years)	15 (15 – 16)
Body weight (kg)	50 (35 – 90)
Height (m)	1.56 (1.42 – 1.75)
Menstrual histories	
Menarche(years)	12 (9 – 15)
Menstrual duration(days)	7 (3 – 14)
Menstrual cycle	**N (%)**
Irregular	29 (22.1%)
Regular	102 (77.9%)

All non-bloody vaginal discharges accompanied by at least one distressing symptom were categorized as pathological leukorrhea. These symptoms included itching, pain, unusual odor, and cloudy secretions that had been experienced for at least the past month. We found that 71% of respondents experienced pathological leukorrhea, with itching and odor as the two dominant symptoms. There are only 38 (29%) respondents who did not experience any grievance during leukorrhea. The data on these symptoms are presented in Table 2.

Table 2. The accompanying distressing symptoms among respondents with leukorrhea

Symptoms	N (%)	Leukorrhea
Itching	73 (55.7%)	Pathological 93 (71%)
Smells (specific odor)	27 (20.61%)	
Lower abdominal pain	9 (6.9%)	
Cloudy colored secretes	24 (18.32%)	
No symptoms	38 (29%)	Non-pathological

The respondents predominantly experienced pathological leukorrhea (71%). They were mostly characterized by normal nutritional status (73.2%), normal levels of stress (52%), and low immune status (59.6%). The chi-square test confirmed an association between low immune status and pathological leukorrhea (P= 0,027). Respondents with a low immune status had a 1.295 times higher risk of pathological leukorrhea. However, Fisher's exact test confirmed that there was no association between nutritional status (P= 0.977) or the level of psychological stress (P= 0.162) with pathological leukorrhea. Thus, neither nutritional status nor the level of psychological stress was identified as a primary risk factor for pathological leukorrhea. The associations between the risk factors and pathological leukorrhea are summarized in Table 3.

Table 3. The associations between risk factors with pathological leukorrhea

Variables	Leukorrhea n (%)		p	OR (95% CI)
	Pathologic	Non-Pathologic		
Nutritional status				
Obese	10 (76.92)	3 (23.07)		
Overweight	13 (72.22)	5 (27.77)		
Normal	67 (69.79)	29 (30.21)	0.977	
Underweight	3 (75)	1(25)		
Psychologic stres				
Extremely severe	7 (77.77)	2 (22.22)		
Severe	12 (70.58)	5 (29.41)		
Moderate	20 (90.90)	2 (9.09)		
Mild	9 (60)	6 (40)	0.162	
Normal	45 (66.17)	23 (33.82)		
Immune status				
Low	61 (78.20)	17 (21.80)	0.027*	1.295 (1.011-1.659)
High	32 (60.38)	21 (39.62)		

* Significant at P< 0.05

We also performed an analysis to confirm a possible relationship between psychological stress and immune status. There was a significant relationship between psychological stress and the immune status (P-value = 0.005).

Table 4. Associations between the level of psychological stress and immune status

Variables	Immune status n (%)		p
	Low	High	
Psychologic stress			
Extremely severe	7 (77.77)	2 (22.22)	
Severe	13 (76.47)	4 (23.53)	
Moderate	10 (66.67)	5 (33.33)	
Normal	30 (44.11)	38 (55.88)	0.005*
Mild	9 (60)	6 (40)	

* Significant at P< 0.05

It explained the stress effect indirectly on leukorrhea via the immune status. However, we did not perform an analysis to confirm the relationship between nutritional status and immune status. The analysis was summarized in the table 4 as follows.

Discussion

The immune status of full-day school students

Being immunocompromised is a primary risk factor for pathological leukorrhea (16). The general immune status significantly influences cervico-vaginal immunity, which forms a crucial component of the mucosal defense against pathogens. Lactobacillus sp. plays a key role in maintaining an acidic environment inside the vagina and inhibiting the growth of pathogens such as Escherichia coli and Trichomonas sp. (22). However, in immunocompromised individuals, the presence of Lactobacillus sp. and lactic acid production are reduced. Consequently, the vagina fails to maintain acidity and loses its natural protection against pathogens. This can lead to bacterial vaginosis, a common form of pathological leukorrhea characterized by a fish-like odor that is not accompanied by inflammation, pain, or itching (7).

Our findings indicate that most respondents were immunocompromised, with a low general immune status. Leukorrhea can progress to pathological leukorrhea in immunocompromised individuals (23). Our findings confirmed that there was an association between general immune status and pathological leukorrhea in female students. Immunocompromised female students were 1.295 times more likely to experience pathological leukorrhea and distressing symptoms.

The psychological stress status of full-day school students

An immunocompromised status was most commonly found in individuals experiencing distress who failed to cope with psychological stressors. Distress is often associated with an elevated cortisol level (24-25). Based on our findings, as seen in Table 4, more than 50% respondents with low immune status experienced moderate stress or more severe stress. There was a significant association between the level of stress and general immune status (P= 0.005).

Immunocompromised individuals are more prone to various diseases or disorders throughout the year, such as influenza, diarrhea, and dermatitis (26). Based on our findings, the Immune status questionnaire recorded among students with moderate or high degrees of stress was more likely to suffer from diseases more frequently throughout the year. Since the level of stress was associated with the immune status, it was also presumed to be associated with pathologic leukorrhea. As seen in Table 3, there was no association between psychological stress and pathologic leukorrhea among full-day school students (P= 0.162). Our findings confirmed that distress was not a factor associated with pathologic leukorrhea.

Psychological distress was not directly associate on the grievance of pathological leukorrhea among full-day school students. Pathological leukorrhea was found among respondents with distress status only if they also had a low immune status. Based on our findings, all distressed respondents had low immune status, but less than 40% distress respondent was experienced pathologic leukorrhea.

The nutritional status of full-day school students

Nutritional status was assessed based on WHO criteria for z scores of BMI among subjects aged 15-16 years old. The WHO categorizes nutritional status into four groups: underweight, normal-weight, overweight, and obese. Based on our findings, most respondents (69%) were within the normal nutritional status range. Normal nutritional status, characterized by balanced food consumption and appropriate utilization of nutrients, is not associated with the occurrence of diseases or syndromes, particularly pathological leukorrhea (14).

Normal nutritional status was not a risk factor for any pathological process or diseases. As seen on table 3, there was not any association between nutritional status with pathological leukorrhea among full-day school students (P= 0.977). However, previous studies revealed that being underweight is associated with the female triad syndrome of low energy availability, menstrual disorders, and osteoporosis (15). Being overweight or obese were primary risk factors for metabolic disorders, such as diabetes mellitus, dyslipidemia, and cardiovascular events,

also associated with a higher risk for infection (16).

The study by Jin X et al. reported that the immune response was found to be lower in overweight and obese individuals than in normal individuals (16), and symptoms of pathological leukorrhea were mostly found among obese and overweight individuals with an immunocompromised status (17). Our findings did not support a link between nutritional status and symptoms of pathologic leukorrhea, because of low immune status respondents were found to have a normal nutritional status in 60.4% of cases.

Since full-day school was present, this was study who revealed factors associated with pathologic leukorrhea among female students for first time ever. Leukorrhea was considered as negative behavior related disease among female student in Indonesia. There always be negative stigma for adolescents who experienced with pathologic leukorrhea. Online version of questionnaires free the student from negative stigma to answer the questions. Because of many questions to be answered, major was bored during data collections. We performed it in phases with time breaks in between. Demographics data were not characterized in this study. Further it was needed to be included as subject characteristic which analyzed for potential association

Conclusion

Pathological leukorrhea is characterized by leukorrhea accompanied by distressing symptoms, which are closely associated with general immune status, particularly an immunocompromised status. Among female students in a full-day school, levels of distress were associated with an immunocompromised status. Further studies are required to explore the distribution of pathological leukorrhea based on specific symptoms and their association with immune status and levels of stress.

Declerations

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Conflicts of interest

The authors declared no conflicts of interest.

Ethical considerations

Informed written consent was obtained from subjects and their parents, and the data were collected anonymously. Respondents and their parents were informed of the purpose of the study and their right to refuse or answer the questionnaire, and they were given the choice to stop or withdraw at any time.

Code of Ethics

All procedures in this study were approved by the Medical Research Ethics Commission, Faculty of Medicine, Universitas Airlangga, as stated in the ethical clearance statement no. 8/EC/KEPK/FKUA/2024

Use of Artificial Intelligence (AI)

Not applicable.

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Authors' contribution

PB and ARB conceptualized and designed the study and participated in preparing the last draft; SS prepared the last draft. YRT wrote the first draft. AA conducted the data analysis. YRT and PAC performed data gathering. All authors approved and verified the last draft.

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