

ORIGINAL SCIENTIFIC PAPER

The Association between Regular Sports Participation and Immune Status in College Students Using Immune Status Questionnaire

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Abstract

College students may lack physical activity due to academic burden. This puts them at a higher risk of decreased immunity. This study aimed to investigate the association between sports participation and immune status. This was a cross-sectional retrospective study. Participants were 170 Atma Jaya Medicine and Health Science School students consisting of 59 boys (34.7%) and 111 girls (65.3%). Seventy-nine (46.5%) students participated in the Sports Students Club from December 2021 - December 2022, and 91 did not (53.5%). There were four sports, i.e., badminton, basketball, futsal, and volleyball. Data was taken from July-August 2023. Immune status was assessed using the Indonesian Immune Status Questionnaire (ISQ) version. The amounts of boys engaged in sports activity was significantly greater than girls [45(76.3%) vs 34(30.6%), $p=0.001$]. One hundred eleven students (65.3%) had good immune status, consisting of 65 girls (58.6%) and 46 boys (78%); 59 students (74.7%) participated in sports, and 52 students (57.1%) did not. Sex and sports participation were associated with immune status ($p=0.000$ and $p=0.017$, respectively). Students with good immune status had higher final ISQ scores than those with poor immune status (8.37 ± 1.4 vs 3.84 ± 1.4 , $p=0.000$). Skin problems, headache, and muscle joint pain (MJP) were the three most common illnesses. Sports participation was a protective factor for skin problems, headache, and MJP (OR 0.27, 0.34, 0.41; 95%CI 0.14-0.53, 0.17-0.67, 0.20-0.84; $p=0.000$, 0.002, 0.013, respectively). Regular sports participation is associated with favorable immune status. Sport participation could be a protective factor for some symptoms.

Keywords: *physical activity, immune system, immune assessment, low immune symptoms, young people*

Introduction

Campus life is marked by academic challenges, increased social interaction, and strengthening students' independence (Worsley et al., 2021). However, campus life also causes students to experience stress, have irregular sleep patterns, and adopt an unhealthy lifestyle (Cena et al., 2021). Academic success, controlling social relationships, and planning for the future are significant stressors. Stress can cause anxiety, depression, and other mental health problems in college students (Mofatteh, 2020).

Stress can harm and weaken the immune system, making people more susceptible to infections, illnesses, and other

health problems (Bains & Sharkey, 2022). Stress hormones, such as cortisol and adrenaline, will be released in response to deal with immunity threats. An increase in stress hormones causes immune cells to become less effective (Morey et al., 2015). This weakened immune response increases vulnerability to infection and can decrease the body's ability to fight diseases (Bains & Sharkey, 2022).

Previous studies have shown a link between exercise and the immune system. Exercise can directly increase immunity through increasing immunological activity or indirectly through reducing stress, sleeping better, and improving psychological health (Nieman & Wentz, 2019; Abd El-Kader & Al-



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Jiffri, 2020). Increased immunological activity due to exercise through increased blood circulation, thereby facilitating the transport of immune cells throughout the body. This increases the ability of immune cells to more effectively detect and neutralize pathogens, thereby reducing the risk of infection. Also, exercise triggers the release of endorphins, reducing stress and anxiety levels (Harber & Sutton, 1984). Lower stress levels are associated with a more robust immune response, making students more resistant to diseases.

Assessing the immune system is essential for overall health status and detecting potential vulnerabilities. There are several ways to evaluate the immune system. The method most frequently used is an objective qualitative and quantitative assessment of blood samples, such as the number and type of immune cells and mediators such as cytokines, chemokines, and antibodies (Institute of Medicine (US) Committee on Military Nutrition Research, 1999; Liu, 2021). However, these methods are usually expensive, time-consuming, and invasive. In addition, this method does not provide information on immune status from an individual perspective.

The Immune Status Questionnaire (ISQ) is a simple method designed to evaluate the health and function of a person's immune system by answering questions. The ISQ was developed from the Immune Fitness Questionnaire (IFQ) by simplifying complaints about decreased immunity and individual perceptions of their immune system (Reed et al., 2015; Versprille et al., 2019). The ISQ consists of seven questions regarding the patient's current complaints and opinions regarding his health and immune status. ISQ can be part of routine health checks so that health practitioners can proactively treat diseases related to decreased immunity before they worsen. Because it is simple and easy, the ISQ can also be used for mass screening of health and immune status so that it can be administered to determine the immune status of the community (Versprille et al., 2019).

Several previous studies have been conducted on the positive relationship between exercise and immune status in students. A study among Korean adolescents indicated that sports participation positively affected wellness (Lee et al., 2021). Physically inactive reduced immune status among Arabian teens has also been reported (Alharbi et al., 2023). Participation in sports and exercise could reduce anxiety, depression, and obesity and improve immune status among university students in Bangladesh (Hossen et al., 2020). Students' participation in sports and physical exercise tends to decrease

by up to a third during university education (Bray & Born, 2004; Kwan et al., 2012; Sigmundová et al., 2013). However, studies on regular sports' effect on college students' immune status in medical students have yet to be widely studied. This study investigates the relationship between regular sports and immune status in medical students as assessed by ISQ.

Methods

Design

This study was cross-sectional with a retrospective approach conducted at Atma Jaya Catholic University of Indonesia, Jakarta, from July 2023 to August 2023.

Participants

Participants were 170 Atma Jaya Medical Students, including 111 females (65.3%) and 59 males (34.7%). The students who regularly participated in sports through the Student Sports Club in December 2021-December 2022 at least twice a week were recorded. Students participated in four sports: badminton, basketball, futsal, and volleyball. The students who had never participated regularly or less than twice a week in sports and exercise in or outside the campus were considered not to participate in sports. Participants with immune diseases, allergy history, chronic diseases, and taking immunosuppressant drugs were excluded. This study was approved by the ethics committee of the School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, with approval number 27/06/KEP-FKIKUAIJ/2023.

Immune Status Questionnaire

The validated Indonesian version of the ISQ was used (Azhar, Erdiansyah, & Rudiman, 2022). The Immune Status Questionnaire (ISQ) consists of seven immune-associated symptoms and complaints experienced over the last 12 months: sudden high fever, diarrhea, headache, skin problems (e.g., acne, eczema), muscle and joint pain (MJP), common cold, and coughing. Each symptom and complaint is scaled with a 5-point Likert scale ranging from 0-4 with 'never,' 'sometimes,' 'regularly,' 'often,' and 'almost/always.' The score obtained from the Likert scale is the raw score, ranging from 0-28. The raw score is then converted to a final score of ISQ from 0-10, as shown in the table. A higher raw score will become a lower final score and indicate a poorer immune status. The final ISQ score <6 is cut off for decreased immune function (Versprille et al., 2019).

Table 1. The ISQ score conversion

Raw Score	Final Score
≥ 15	0
14	1
13	2
11,12	3
10	4
8,9	5
7	6
6	7
5	8
3,4	9
≤ 2	10

Statistical Analysis

Numeric data was presented as mean±SD, while categorical data was presented as the number of participants (and frequency). Unpaired student t was applied to analyze differences in ISQ final score between the compared groups. The Chi-square or Fisher exact test was used to analyze the relationship between categorical variables (2x2 table), while Kolmogorov-Smirnov (KS) was used for the AxB table. ANOVA, followed by an LSD post hoc test, was applied to compare the mean between sports groups. The results were significant if p<0.05. Descriptive and analytics statistics were processed using SPSS 19.

Results

Table 2. demonstrates the characteristics of the participants. Seventy-nine participants (46%) participated regularly in sports through the Student Sports Club (30.6% of females, 76.3% of males). Among 79 participants, 28 (35.4%) participated in futsal, 26 (32.9%) in badminton, 13(16.5%) in basketball, and 12 (15.2%) in volleyball. One hundred and eleven (65.3%) participants are considered to have 'good' immune status. The final ISQ score is 6.80±2.6.

Table 3. presents the association between the immune status with sex and sports participation. Sixty-five (58.6%) girls

Table 2. Characteristics of participants

	Frequency or mean±SD	Percentage
Sex		
Girls	111	65.3%
Boys	59	34.7%
Sport Participation		
Yes	79	46.5%
No	91	53.5%
Sport type		
Futsal	28	35.4%
Badminton	26	32.9%
Basketball	13	16.5%
Volleyball	12	15.2%
Immune status		
Good	111	65.3%
Poor	59	34.7%
Final ISQ score (mean±SD)	6.80±2.6	-

ISQ: immune status questionnaire

and 46 (78%) boys have a 'good' immune status. The association between immune status and sex is significant (p=0.000). Fifty-nine (74.7%) students participating in sports and 52 (57.1%) not participating in sports have a 'good' immune sta-

tus. The association between immune status and sports participation is significant (p=0.017). Participants with 'good' immune status have greater final ISQ scores than those with 'poor' immune status (8.37±1.4 vs 3.84±1.4, p=0.000).

Table 3. The association between immune status with sex and sports participation

	Immune status		Overall	p
	Good (n=111)	Poor (n=59)		
Sex				
Girls	65 (58.6%)	46 (41.4%)	111 (100%)	0.000
Boys	46 (78%)	13 (22%)	59 (100%)	
Sports participation				
Yes	59 (74.7%)	20 (25.3%)	79 (100%)	0.017
No	52 (57.1%)	39 (42.9%)	91 (100%)	
Final ISQ score (mean±SD)	8.37±1.4	3.84±1.4	-	0.000

ISQ-Immune Status Questionnaire

The association between sports type with sex and immune status and the difference in final ISQ score is shown in Table 4. Of the 79 students who participated in sports, 34 were girls (30.6% of girls) and 45 were boys (76.3% of boys). The association between sex and sports participation is significant (p=0.001). Kolmogorov-Smirnov test

indicates no association between sports type and immune status (p=0.96). However, ANOVA indicates that the mean final ISQ scores between sports types differ significantly (p=0.044). Further post-hoc analysis shows that only the badminton and volleyball final ISQ scores differ (8.42±2.0 vs 6.33±2.7, p=0.039).

Table 4. The association between sports type with sex and immune status

	Badminton	Basketball	Futsal	Volleyball	Overall	p
Sex						
Girls (n=111)	6	11	9	8	34 (30.6%)	0.001
Boys (n=59)	20	2	19	4	45 (76.3%)	
Immune status						
Good (n=111)	21	10	21	7	59 (74.7%)	0.96
Poor (n=59)	5	3	7	5	20 (25.3%)	
Final ISQ score	8.42±2.0	7.69±2.3	7.43±2.1	6.33±2.7		0.044

ISQ-Immune Status Questionnaire

Immunity-related complaints of ISQ are presented in Table 5. Skin problems, headache, and muscle joint pain are the top three complaints felt by participants, with a percentage of 40%, 32.4%, and 28.2%, respectively. Sudden high fever is the least experienced complaint by participants (5.9%).

The association between sports participation and immunity-related complaints of ISQ is then explored and described

in Table 6. The five symptoms' frequency of a Likert scale was then adjusted into two categories: 'absent' and 'present'. 'Never' and 'sometimes' of the Likert scale become 'absent', while 'sometimes-always' becomes 'present'. The association between variables was analyzed by Chi-square, except between sports participation and diarrhea by Fisher's exact test. The results indicated that headache, skin problems, and MJP

Table 5. Distribution of symptoms and complaints of ISQ

	Never	Sometimes	Regular	Often	Always	Total complaint	Percentage
Skin problems	49	53	45	20	3	68	40.0
Headache	36	79	41	12	2	55	32.4
Muscle joint pain (MJP)	49	73	34	13	1	48	28.2
Coughing	63	78	27	1	1	29	17.1
Common cold	71	70	25	4	-	29	17.1
Diarrhea	81	65	21	3	-	24	14.1
Sudden high fever (SHF)	121	39	10	-	-	10	5.9

Table 6. The association between sports participation and each symptom and complaint

No		Sport participation		Odd risk	95% CI	p
		yes	no			
1	SHF					
	absent	76	84	0.47	0.12-1.90	0.342
present	3	7				
2	Diarrhea					
	absent	71	75	0.53	0.21-1.31	0.164
present	8	16				
3	Headache					
	absent	63	52	0.34	0.17-0.67	0.002
present	16	39				
4	Skin problems					
	absent	60	42	0.27	0.14-0.53	0.000
present	19	49				
5	MJP					
	absent	64	58	0.41	0.20-0.84	0.013
present	15	33				
6	Common cold					
	absent	70	71	0.46	0.19-1.07	0.077
present	9	20				
7	Coughing					
	absent	61	80	2.15	0.94-4.88	0.064
present	18	11				

are associated with sports participation ($p=0.002$, $p=0.000$, and $p=0.013$, respectively). Sports participation has an association with headache, skin problems, and MJP [OR (95%CI) were 0.34 (0.17-0.67), 0.27 (0.14-0.53), and 0.41 (0.20-0.84), respectively].

Discussion

The use of ISQ to assess immune status has probably been widely used. However, ISQ may not be commonly used to assess the immune status of college students participating in sports. This study explores the relationship between immune status and sports participation using ISQ. Our findings demonstrate that 65.3% of students have good immune status. Also, sports participation and sex are linked to better immune status. Students who participate regularly in sports have better final ISQ scores and immune status. Further investigation shows that students who participated in volleyball have better immune status than those who participated in other sports. Participation in sports is associated with several complaints about decreased immunity, i.e., headache, skin problems, and MJP.

Physical exercise has positive and negative impacts on the immune system and response. Exercise duration and intensity influence the positive or negative impacts of exercise (Nieman & Wentz, 2019; Forte, Branquinho, & Ferraz, 2022). Positive effects on the immune response are usually achieved at moderate intensity and appropriate duration. Some RCT studies reported that moderate exercise reduced incidence, days of illness, and disease severity (Barrett et al., 2012; Barrett et al., 2018). Several previous studies reported that sports participation improves immune function in students (Hossen et al., 2020; Lee et al., 2021; Alharbi et al., 2023). Even though there were differences regarding methods, immunity questionnaires used, and variables, the results were in line with the results of our study.

Otherwise, strenuous exercise attenuates the immune system and response. Studies involving long-distance runners, elite track and field athletes, and elite aquatic athletes indicated varying incidence of illness up to 6 times in those athletes (Nieman et al., 1993; Alonso et al., 2012; Prien et al., 2017; Timpka et al., 2017). Our findings show that most students who participated in sports had good immune status, indicating that sports participation positively impacted immune status and that the sports activity might be performed at moderate intensity. Also, our study revealed that students participating in volleyball had better immunity than in badminton. The effect of sports type on immunity has been investigated (Isaev et al., 2018). A possible mechanism for the difference in immunity between sports types has not been proposed, but it might be linked to sports work duration and intensity (Isaev et al., 2018).

The influence of sex on the immune system has been widely discussed but remains inconclusive. Many interfering factors, including age, reproductive status, sex chromosomes, sex hormones, and environmental factors, may cause the discrepancy between studies (Klein & Flanagan, 2016; Sciarra, Campolo, Franceschini, Carlomagno, & Venneri, 2023). Also,

the immune system contains many immune elements (i.e., phagocytic capacity, cytokines production, natural killer cell number, antibody production, and expression of inflammation mediators) whose activities are different between males and females (Klein & Flanagan, 2016; Wilkinson, Chen, Lechner, & Su, 2022). Therefore, it cannot be concluded which gender has better immunity. However, our study indicated that sex was related to immune status, and girls had lower final ISQ scores. The number of girls participating in sports is significantly fewer than that of boys. This may cause girls' final ISQ score and immune status to be statistically lower than boys.

This study's three most common complaints were skin problems, headaches, and MJP. These three complaints were also related to sports participation. Also, sports participation is a protective factor for skin problems, headaches, and MJP. Most previous studies reported upper respiratory tract infection (URTI) and upper respiratory symptoms were the most common illness in sports. Gastrointestinal disturbances and skin problems are common diseases in athletes (Mellman & Podesta, 1997; Ahmadinejad, Alijani, Mansori, & Ziaee, 2014; Jaworski & Rygiel, 2019; Kelly, Pollock, Polglass, & Clarsen, 2022). However, our findings showed a different illness pattern. The slight differences in the patterns of the most common illnesses in sports may also be due to differences in participant characteristics. Headaches, for example, are rarely found in professional athletes but often in student-athletes. Academic problems might be the differentiator of health problems between professional and student-athletes.

Limitations of this study should be acknowledged. First, sample size was a significant issue of our study. A larger sample will increase the reliability of the results. Our study's smaller sample size was due to students' low participation in sports activities after the COVID-19 pandemic. Second, immunity is a system, not a single entity. Many factors influence immunity, including nutrition, resting time, and psychological problems. Thus, recording those influencing factors could minimize bias. Third, immune status from ISQ would be more reliable and valid if confirmed by laboratory examination, a routine and standard method. Last, only four types of sports are involved out of so many types of sports. Involving many sports types with different characteristics will advance helpful information for those involved in sports. Future studies should involve a larger sample size and many sports types, recording the duration and intensity of sports activity and confirming ISQ with laboratory methods.

Conclusion

This study links immunity, sports participation, and sex in college students. Immunity is unrelated to sports type, but the final ISQ score in volleyball is greater than in badminton. The pattern of most diseases is different from the pattern in professional athletes. Sports activity is a protective factor for some complaints in ISQ. However, the findings of this study should be interpreted with caution due to some limitations. Our results could be used to encourage students to engage in sports activity and to encourage schools to facilitate sports activity.

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Conflict of interest

The authors declare no conflict of interest.

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