International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 5, 2025
https://theaspd.com/index.php

Assessing Academic Stress And Sleep Quality As Modifiable Risk Factors For Early Rheumatoid Arthritis In Indonesian University Students

Yuswanto Setyawan[1]
[1] Faculty of Medicine, Ciputra University, Surabaya, Indonesia.
Corresponding author at: yuswanto_setyawan@yahoo.com

Abstract
Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disease whose early detection remains limited among young adults. University students represent a vulnerable group due to high academic stress and lifestyle factors that may trigger early inflammatory symptoms. This study examines the influence of individual factors, academic stress, and sleep quality on the risk of early RA symptoms among Indonesian university students. A cross-sectional quantitative design was employed with 110 active undergraduate students selected through convenience sampling. Data were collected using an online questionnaire including demographics, the Perceived Stress Scale (PSS-10), the Pittsburgh Sleep Quality Index (PSQI), and an RA Symptom Checklist adapted from the EULAR criteria. Multiple linear regression analysis was conducted to assess relationships among variables. The results showed that individual factors, particularly BMI, physical activity, and family history, significantly predicted early RA symptom risk ($\beta = 0.503$, $p < 0.001$). Academic stress had a significant negative relationship ($\beta = -0.165$, $p = 0.050$), indicating that students with better stress management are less likely to show early RA symptoms. Sleep quality did not significantly predict RA risk ($p = 0.396$). The model explained 28.1% of variance in RA symptom risk. These findings highlight the importance of promoting healthy lifestyles, stress management, and early autoimmune awareness among university students. Future research should integrate biomarker data and longitudinal design to confirm causality and expand understanding of early RA risks in young populations.
Keywords: *Rheumatoid Arthritis, Academic Stress, Sleep Quality, Individual Factors, University Students, Early Detection*

1. INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease that attacks the synovial joints, causing pain, swelling, stiffness, and potentially permanent disability if not managed optimally [1]. Globally, RA affects an estimated 0.5-1% of the adult population, with significant economic and social burdens, particularly in developing countries that lack effective early detection programs [2]. The World Health Organization [3] also highlights that autoimmune diseases such as RA represent a growing public health burden in line with changing lifestyles, environmental stressors, and increasing mental health pressures.

In Asia, a meta-analysis by [2] shows RA prevalence among Asian populations ranges from 0.2% to 0.5%, with a tendency to rise among productive age groups. In Indonesia, national data remain fragmented, but [4] found that behavioral and lifestyle factors significantly influence the risk of RA relapse, including excessive physical activity and unhealthy habits. These findings underscore the importance of risk mitigation from an early age, especially in the initial phase when mild RA symptoms often appear.

University students represent an emerging adult population highly vulnerable to psychosocial stress. Rahmawati et al. [5] found that Indonesian students, particularly freshmen, face high risks of mental health problems due to academic culture shock, overwhelming coursework, and anxiety over academic performance. According to WHO [3], mental health is a state of well-being in which individuals can cope with life stressors, work productively, and contribute to their communities. When mental well-being is disrupted, cognitive, emotional, and biological systems may also be affected.

Theoretically, the Psychosocial Stress Theory emphasizes that chronic stress activates the hypothalamic-pituitary-adrenal (HPA) axis, raising cortisol levels and triggering systemic inflammatory pathways that may lower immunity [6], [7]. HPA responses also differ by gender; women generally have a more reactive HPA axis due to sex hormones, making them more prone to autoimmune diseases, anxiety, and depression [7]. This is relevant because RA epidemiologically affects more women during reproductive age [1].

Besides academic stress, sleep quality plays an essential role in maintaining immune balance. Kim et al. [8] found that poor sleep quality exacerbates joint pain and lowers the quality of life for RA patients. A study by [9] using the UK Biobank showed that individuals with RA are at higher risk of insomnia, excessive daytime naps, and cognitive impairment. Zhang et al. [10] also confirmed that sleep disturbances worsen joint inflammation by increasing proinflammatory cytokines.

In Indonesia, Rahmawati et al. [5] observed that students with mental health disorders often have poor sleep quality and significantly declining academic performance. However, few studies have specifically examined how individual factors, academic stress, and sleep quality together influence the risk of early RA symptoms among students. In reality, early RA symptoms are often subtle, such as morning joint stiffness, unexplained fatigue, or mild joint pain, and are frequently overlooked.

Given these conditions, this research is crucial to map the extent to which individual factors, academic stress, and sleep quality affect the risk of early RA symptoms among Indonesian university students. This study adopts the Psychosocial Stress Theory and the Sleep Hygiene Model to fill the research gap and support early detection efforts for autoimmune risk among productive age groups. Therefore, this study, titled "The Influence of Individual Factors, Academic Stress, and Sleep Quality on the Risk of Early Rheumatoid Arthritis Symptoms among Indonesian University Students," aims to answer whether academic stress significantly affects RA risk, whether sleep quality significantly affects RA risk, and whether individual factors influence the risk of early RA symptoms in students.

2. LITERATURE REVIEW

2.1 Individual Factors

Individual factors play a fundamental role in determining a person's susceptibility to autoimmune disorders, including rheumatoid arthritis (RA). Demographic characteristics such as age, gender, and field of study can indirectly contribute to stress levels, lifestyle choices, and biological vulnerability. Smolen, Aletaha, and McInnes [1] noted that RA prevalence is higher among women of reproductive age due to hormonal influences that modulate the immune system's response. Body Mass Index (BMI) is also an important indicator, as excessive weight and obesity are linked to increased systemic inflammation, which can exacerbate the risk of RA symptoms [2]. Furthermore, the presence of regular physical activity has been shown to reduce inflammatory markers and improve immune balance. A family history of autoimmune disease remains one of the strongest predictors of genetic predisposition to RA [4]. Understanding these factors is crucial for identifying early warning signs and implementing targeted preventive measures. This study thus includes individual characteristics such as age, gender, field of study, BMI status, physical activity habits, and family history of RA to comprehensively assess students' baseline risk levels.

2.2 Academic Stress

Academic stress is a condition of psychological pressure frequently experienced by university students due to heavy academic workloads, performance competition, tight class schedules, and family expectations. This stress arises when students perceive academic demands as exceeding their adaptive capacity. According to the Psychosocial Stress Theory [6], prolonged psychosocial stress can trigger activation of the hypothalamic-pituitary-adrenal (HPA) axis. This activation stimulates excessive release of the stress hormone cortisol. Chrousos [7] explains that elevated cortisol affects the release of inflammatory mediators and proinflammatory cytokines such as interleukin-6 (IL-6) and TNF-α. The increase in these cytokines can lower immune function and may trigger chronic inflammation. This pathway is relevant for explaining the link between chronic stress and autoimmune diseases such as rheumatoid arthritis (RA). Research by [11] supports this theory by finding a significant relationship between high perceived stress and inflammatory joint conditions in individuals with autoimmune predispositions. In Indonesia, [5] showed that first-year students are highly vulnerable to academic stress as they must adapt to new learning systems, heavy assignments, and social pressures. Poorly managed stress reduces concentration, academic performance, and affects sleep patterns. Women are more prone to chronic stress due to differences in hormonal regulation. Chrousos [7] emphasized that estrogen increases the sensitivity of the HPA axis, making women more susceptible to autoimmune diseases. This aligns with the findings of [1] who reported that RA is more prevalent among women of reproductive age. Therefore, a deep understanding of academic stress, the HPA response, and its risks is essential for early detection of autoimmune risk among students. The measurement instrument for academic stress in this study uses the Perceived Stress Scale developed by [6], which is widely applied internationally to assess individuals' perceived stress levels.

2.3 Sleep Quality

Good sleep quality plays a vital role in maintaining the body's immune system balance. Sleep is not merely a phase of physical rest but also an essential period for cellular recovery, hormonal regulation, and stress response reduction. Kim et al. [8] explained that rheumatoid arthritis (RA) patients with poor sleep quality tend to experience more severe joint pain, chronic fatigue, and a significant decline in quality of life. Sleep disturbances trigger increased production of proinflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which can worsen joint inflammation and accelerate disease progression [9]. Among university students, sleep quality problems remain a challenge that is often overlooked. Students often have habits of staying up late, shortened sleep duration, and irregular sleep schedules due to demanding academic workloads, assignments, and frequent late-night gadget use [5]. Poor sleep patterns contribute to decreased cognitive function, weakened immunity, and increased daily fatigue. If prolonged, this condition may disrupt growth hormone release, lower cell regeneration quality, and weaken immune defense. Zhang et al. [10] through a systematic review confirmed that chronic sleep disorders are closely linked to increased systemic inflammation, making individuals more susceptible to joint inflammation such as RA. Moreover, poor sleep quality can worsen psychological stress, creating a vicious cycle of fatigue, stress, and declining immunity. A study by [9] on more than 480,000 UK Biobank respondents found that people with RA generally have lower sleep quality scores, a tendency for insomnia, and interrelated cognitive problems. Therefore, maintaining optimal sleep quality serves as an important protective factor to minimize the risk of autoimmune inflammation, especially for students in their productive age. Sleep quality in this study was measured using the Pittsburgh Sleep Quality Index (PSQI) developed by [12] and widely validated for assessing individual sleep quality.

2.4 Rheumatoid Arthritis (RA)

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease that attacks the synovium, the thin lining of the joints. This inflammatory process causes pain, swelling, joint stiffness, reduced mobility, and can lead to permanent disability if not detected and managed early. Globally, RA affects approximately 0.5-1% of the adult population, with prevalence rates varying by region [2]. In Asia, the prevalence of RA is reported to range from 0.2-0.5% and is expected to rise due to changing lifestyles, urbanization, and high levels of psychosocial stress during productive ages. According to [1], RA is more common among women, especially within reproductive age groups. Hormonal factors such as estrogen can influence immune response regulation, making women more susceptible to developing autoimmune diseases, including RA. In Indonesia, national prevalence data remain limited. However, a study by [4] conducted in East Java indicated that risky lifestyles, excessive physical activity, chronic stress, and unhealthy diets are significant factors contributing to RA symptom relapses. Early symptoms of RA are often nonspecific, such as morning joint stiffness, excessive fatigue, and mild pain in small joints like fingers or wrists. Because these early signs are frequently mistaken for general tiredness, many patients are only diagnosed once joint damage has already occurred. Early detection of risk factors is therefore crucial as a preventive strategy. The link between chronic stress and sleep disturbances with autoimmune inflammatory risk is supported by various global studies. Prolonged stress activates the HPA axis, potentially triggering the release of inflammatory mediators, while sleep disorders contribute to cytokine imbalances. University students, as a productive-age group, experience high levels of academic stress and often have poor sleep habits. This makes students a high-risk population for undetected early RA symptoms. Therefore, examining the relationship between academic stress and sleep quality with the risk of early RA symptoms among Indonesian students is highly relevant to support preventive efforts and autoimmune health education for young populations. The risk of early RA symptoms in this study was identified using an RA Symptom Checklist adapted from the European League Against Rheumatism (EULAR) criteria for early RA detection [13].

3. METHODOLOGY

3.1 Participants & Procedures

This study employed a quantitative correlational design with a cross-sectional approach to examine the relationship between individual factors, academic stress, and sleep quality with the risk of early symptoms of rheumatoid arthritis (RA) among university students in Indonesia. This design is appropriate for analyzing relationships between variables at a single point in time using inferential statistical procedures [14].

The target population comprised active undergraduate students across Indonesia, with no restriction to

any specific university. Participants were recruited through convenience sampling by distributing an online questionnaire via social media, student communities, and academic networks. Inclusion criteria included active enrollment in at least the second semester, willingness to complete the questionnaire independently, and no prior medical diagnosis of autoimmune disease. The estimated minimum sample size was approximately 100-150 students, considering a 95% confidence level and a 5% margin of error. The independent variables in this study were individual factors, academic stress, and sleep quality, while the dependent variable was the risk of early RA symptoms. Individual factors included age (17-22 or 23-28), gender (male/female), field of study (science/social science), body mass index (BMI) calculated from self-reported height and weight (categorized by Asia Pacific WHO standard), physical activity (regular ≥30 minutes daily; yes/no), and family history of RA (yes/no). Academic stress was measured using five Likert-scale items adapted from the Perceived Stress Scale (PSS-10) by [6], covering perceived psychological pressure, inability to control important things, difficulty coping with problems, lack of confidence in coping with stress (reverse item), and frequency of negative emotions. Sleep quality was measured using six items from the Pittsburgh Sleep Quality Index (PSQI) by [12], including average sleep duration (in hours, categorized), subjective sleep quality, difficulty falling asleep, nighttime awakenings, tiredness upon waking (all using a Likert scale 1-5), and use of sleeping pills (yes/no). The risk of early RA symptoms was assessed using a checklist adapted from the European League Against Rheumatism (EULAR) criteria [13], including morning joint stiffness, mild joint pain, unusual fatigue, and swelling in small joints (all coded as yes/no).

3.2 Statistical Analysis

Data were collected using an online questionnaire hosted on Google Forms. The instrument comprised four sections: (1) individual factors and demographic questions, (2) PSS-10 items for academic stress, (3) PSQI items for sleep quality, and (4) an RA Symptom Checklist for early RA indicators. Prior to participation, all respondents received an explanation of the study's purpose and provided informed consent confirming voluntary and confidential participation.

Data analysis was conducted using SPSS. Descriptive statistics summarized participant characteristics. Correlation analyses (Pearson or Spearman) tested bivariate relationships. Multiple linear regression was used to test the simultaneous effect of individual factors, academic stress, and sleep quality on the risk of early RA symptoms. Statistical significance was set at $p < 0.05$.

This research complies with ethical principles by ensuring respondent confidentiality. Participation was voluntary, and respondents could withdraw at any stage without consequence. All data were used exclusively for academic purposes.

4. RESULTS

4.1 Demographic (Individual Factor)

A total of 110 students were successfully surveyed to describe the basic demographic and individual characteristics relevant to the early risk of rheumatoid arthritis (RA). The majority were aged 23-28 years (58.2%), while 41.8% were in the 17-22 age group. In gender composition, 60.9% of respondents were male and 39.1% were female, showing moderate gender balance. Slightly more students came from social science fields (53.6%) than science and technology (46.4%). Regarding nutritional status, 61.8% had a normal BMI, while 15.5% were categorized as overweight and 22.7% obese, which could imply increased inflammatory risks. Meanwhile, 51.8% reported not doing physical activity for at least 30 minutes daily. Additionally, 43.6% reported having a family history of RA or autoimmune conditions. These results highlight that lifestyle and genetic predisposition remain relevant among young adult populations. Collectively, this demographic profile shows the context in which individual factors may relate to the prevalence of early RA symptoms in students.

4.2 Academic Stress

Academic stress was measured using the PSS-10 scale and classified into low, medium, and high categories. Over half (55.5%) of students experienced moderate levels of stress, while 38.2% fell in the high category, showing that academic demands remain a dominant source of psychosocial stress in student life. Only 6.4% reported low stress levels, indicating that high expectations and workloads persistently affect mental resilience. The cross-tabulation analysis found a significant association between academic stress and RA symptom risk ($p = 0.049$). This suggests that high perceived stress without effective coping strategies may contribute to inflammation pathways, while students with better stress management are potentially more protected against stress-induced health risks.

4.3 Sleep Quality

Sleep quality was also investigated to examine whether poor sleep contributes to early inflammatory conditions. Results showed that 60.9% of students had low sleep quality, 23.6% moderate, and only 15.5% reported good sleep quality. Despite its critical role in restoring immune balance, sleep quality did not show a significant bivariate relationship with RA symptom risk in this analysis ($p = 0.643$). This indicates that among young students, poor sleep alone may not yet translate into measurable early RA symptoms, or that other factors, such as stress management or lifestyle, play a stronger role. This finding reinforces the need to interpret sleep quality alongside other personal and environmental stressors when assessing autoimmune risk.

Table 1. Characteristics of Participants by RA Symptoms Risk Level

Variable	Low Risk n (%)	Medium Risk n (%)	High Risk n (%)	p-value
Age				0.589
17-22 yrs	2 (4.3%)	26 (56.5%)	18 (39.1%)	
23-28 yrs	1 (1.6%)	34 (53.1%)	29 (45.3%)	
Gender				0.097
Male	3 (4.5%)	40 (59.7%)	24 (35.8%)	
Female	0 (0.0%)	20 (46.5%)	23 (53.5%)	
Field of Study				0.168
Science	2 (3.9%)	23 (45.1%)	26 (51.0%)	
Social Science	1 (1.7%)	37 (62.7%)	21 (35.6%)	
BMI				**0.004**
Normal	3 (4.4%)	45 (66.2%)	20 (29.4%)	
Overweight	0 (0.0%)	8 (47.1%)	9 (52.9%)	
Obesity	0 (0.0%)	7 (28.0%)	18 (72.0%)	
Physical Activity (≥30 min)				0.098
Yes	3 (5.7%)	31 (58.5%)	19 (35.8%)	
No	0 (0.0%)	29 (50.9%)	28 (49.1%)	
Family History of RA				0.093
No	3 (4.8%)	37 (59.7%)	22 (35.5%)	
Yes	0 (0.0%)	23 (47.9%)	25 (52.1%)	
Individual Factor				**0.000**
Low	3 (15.8%)	15 (78.9%)	1 (5.3%)	
Medium	0 (0.0%)	26 (68.4%)	12 (31.6%)	
High	0 (0.0%)	19 (35.8%)	34 (64.2%)	
Academic Stress				**0.049**
Low	0 (0.0%)	4 (57.1%)	3 (42.9%)	
Medium	3 (4.9%)	26 (42.6%)	32 (52.5%)	
High	0 (0.0%)	30 (71.4%)	12 (28.6%)	
Sleep Quality				0.643
High	0 (0.0%)	10 (58.8%)	7 (41.2%)	
Medium	0 (0.0%)	13 (50.0%)	13 (50.0%)	
Low	3 (4.5%)	37 (55.2%)	27 (40.3%)	

(IBM SPSS 25.00 Output Data, 2025)

4.4 Hypothesis Testing

The multiple linear regression test confirmed that the individual factor composite significantly predicted RA symptom risk ($\beta = 0.503$, $p < 0.001$), implying that lifestyle and genetic elements have a measurable impact. Academic stress showed a significant negative effect ($\beta = -0.165$, $p = 0.050$), indicating that students who manage academic stress effectively may reduce stress-induced inflammation pathways. In contrast, sleep quality did not significantly influence RA symptom risk ($p = 0.396$). The final model explained 28.1% of the variance in RA risk.

Table 2. Multiple Linear Regression Predicting RA Symptom Risk

Variable	B	SE	Beta	t	p-value
Individual Factor	0.365	0.060	0.503	6.101	0.000

Academic Stress	-0.153	0.077	-0.165	-1.985	0.050
Sleep Quality	-0.052	0.061	-0.071	-0.851	0.396
$R^2 = 0.281$					

(IBM SPSS 25.00 Output Data, 2025)

In summary, the results show that individual and genetic factors increase students' risk of early RA symptoms, while effective academic stress management plays a protective role. Sleep quality was not a significant predictor in this sample.

5. DISCUSSION

The prevalence of self-reported early rheumatoid arthritis (RA) symptoms among Indonesian university students in this study reflects an emerging public health concern that may remain hidden if left undetected. Globally, RA affects about 0.5-1% of adults [1], but our findings indicate that even young people in the productive age group may already show mild signs such as morning joint stiffness, unusual fatigue, or mild joint pain. Although our respondents' average age is far below the typical diagnosis age for RA, this early symptom pattern is worth monitoring, especially in the context of academic stress and lifestyle factors that are highly relevant for this population.

Consistent with prior evidence, our sample shows that female students tend to report early RA symptoms more frequently than males. This supports the view that biological factors, particularly sex hormones such as estrogen, modulate the reactivity of the hypothalamic-pituitary-adrenal (HPA) axis and increase the vulnerability to autoimmune processes [7]. [1], [9] also emphasized that RA is more prevalent in women, particularly during reproductive years when hormonal fluctuations can exacerbate systemic inflammation. This gender difference highlights the importance of gender-sensitive prevention strategies, including stress coping support for female students.

In our regression analysis, individual factors, covering BMI, physical activity, and family history of autoimmune disease, were the strongest predictor of early RA symptoms ($\beta = 0.365$, $p < 0.001$). This aligns with [4] study in East Java, which found that poor lifestyle habits, high BMI, and genetic predisposition were major contributors to RA flare-ups. Internationally, the link between obesity and increased RA risk is well documented [15]. Students with a high BMI are at greater risk due to low-grade chronic inflammation driven by excess adipose tissue, which acts as an endocrine organ producing inflammatory cytokines like TNF-α and IL-6. Physical inactivity further amplifies this effect, reinforcing the necessity for universities to encourage healthy body weight and active lifestyles.

One interesting insight of this study is that academic stress showed a negative but significant relationship with early RA symptom risk ($\beta = -0.153$, $p = 0.050$). This counterintuitive result can be understood through the lens of stress coping effectiveness. A negative beta implies that students with better stress management skills report fewer RA-related symptoms. The Psychosocial Stress Theory [6] suggests that chronic stress activates the HPA axis and elevates cortisol levels, which, if left unmanaged, leads to systemic inflammation [7]. However, if students adopt effective coping mechanisms, such as healthy time management, seeking social support, or engaging in stress-relieving activities, they can buffer this pathway. Consequently, academic stress that is well managed does not contribute to physiological deterioration but instead may protect students from stress-related health issues, including autoimmune responses. This finding supports campus mental health programs and demonstrates the importance of integrating stress management workshops within student services.

This result complements global findings. For example, the UK Biobank study by [9] found that lifestyle risks such as smoking, alcohol use, and BMI showed stronger effects than anxiety or depression on RA development, underlining that while stress is a factor, it often interacts with lifestyle and genetic risks. Our study confirms this interaction pattern in a young Asian context. Although stress is a well-established risk factor for immune dysregulation, its impact can be mitigated by adaptive coping and a healthy lifestyle.

In contrast, sleep quality did not significantly predict early RA symptoms in this study ($\beta = -0.052$, $p = 0.396$). While previous studies have shown that poor sleep is common among RA patients and aggravates pain and fatigue [8], [9], the non-significant result here might reflect the unique sleep behaviors of university students. Young adults frequently compensate for short nighttime sleep with irregular naps and digital device usage, which complicates sleep quality measurement [5]. Moreover, the Pittsburgh Sleep Quality Index (PSQI) may not fully capture the nuances of student sleep patterns, such as weekend catch-

up sleep or culturally accepted late-night study habits.

Another possible reason is that, among healthy young people, short-term sleep disruptions may not yet have a detectable physiological impact. Unlike older RA patients, who experience sleep-related cytokine imbalances contributing to disease activity [10], students might maintain overall immune resilience despite variable slee p. Nonetheless, promoting good sleep hygiene remains crucial, given its known links to mood, cognition, and overall wellbeing.

A notable limitation of this study is its cross-sectional nature. We cannot infer causality or determine whether unmanaged stress and poor sleep precede RA symptoms or whether early inflammatory changes lead to perceived stress and sleep disruption. Longitudinal studies with repeated measures, including biomarkers like cortisol, IL-6, and C-reactive protein, are needed to clarify these pathways. Self-reporting is another limitation; it may introduce recall or social desirability bias, particularly for sensitive items like family medical history or sleep duration. Objective measures such as wearable sleep trackers and clinical autoimmune markers would strengthen future research.

Furthermore, cultural context matters. Indonesian students often receive strong family and community support, which can buffer stress impacts. This cultural resilience might partly explain why stress alone did not emerge as a dominant direct risk factor. It also highlights the need to adapt Western theoretical models like the Psychosocial Stress Theory to local sociocultural contexts.

The finding that individual factors and lifestyle risks still outweigh stress and sleep in predicting early RA symptoms underlines an important prevention message: health promotion among students must prioritize maintaining a healthy weight, active lifestyle, and family history awareness, in addition to stress management and sleep hygiene. Universities should invest in integrated health services combining mental health counseling, physical activity programs, and early screening for autoimmune risk, especially for students with known genetic predisposition.

6. CONCLUSION

In conclusion, this study contributes new evidence that individual factors such as BMI, physical activity, and family history are significant predictors of early RA symptoms among Indonesian university students, while academic stress, when well-managed, appears to offer a protective effect against autoimmune risk. Although sleep quality did not show a significant direct relationship, its known indirect effects on stress and immunity warrant continued attention. These findings emphasize the importance of early health education, routine screening, and campus-based interventions focusing on stress resilience, healthy lifestyles, and autoimmune awareness for young adults.

Future research should expand the sample across multiple regions and integrate objective biological markers to better explain the interplay of stress, sleep, lifestyle, and autoimmunity. By addressing these factors proactively, universities and policymakers can help mitigate the hidden burden of RA and related conditions, protecting students' health before irreversible damage occurs.

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