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# *How Do Circadian Rhythms Affect Allergic Reactions, Such as Allergic Rhinitis?*

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***Abstract.*** The purpose of this study was to investigate the impact of circadian rhythm disruption on allergic diseases, and to analyze it using allergic rhinitis as an example. The research methods included literature review and questionnaire survey. The results showed that sleep quality was significantly positively correlated with the severity of allergic rhinitis symptoms, especially in nasal congestion and sneezing. Sleep rhythm-related indicators and symptoms did not reach statistical significance, but showed a certain trend of correlation. In addition, the symptoms of the subjects were most serious in the morning, and adjusting the medication time could alleviate the symptoms to a certain extent. It is concluded that circadian rhythm and sleep quality play an important role in the occurrence and symptoms of allergic rhinitis, which should be paid attention to in future research and clinical treatment.

***Keywords:*** Circadian rhythm, Allergic rhinitis, Sleep quality, Immune response

## 1. Introduction

The incidence of allergic rhinitis has been increasing in recent years, and the incidence of allergic rhinitis is about 23% worldwide [1]. An epidemiological study of 765 French patients with allergic rhinitis showed a clear circadian rhythm of sneezing, nasal congestion, and runny nose, with a peak at 6 am. About 60-70% of them have their worst allergy symptoms in the morning. Given that it has been demonstrated that almost all immune cells express circadian genes, allergic rhinitis has a clear circadian rhythm [2]. This raises the question of whether individual circadian rhythm stability, as reflected in sleep patterns, contributes to this variation.

In recent years, the increase of irregular sleep schedules and late-night activity among teenagers has grown significantly. This trend may disrupt circadian rhythms and potentially exacerbate allergic rhinitis. This study aims to investigate the relationship between sleep quality—measured using the Pittsburgh Sleep Quality Index (PSQI)—and the episode allergic rhinitis in younger and middle-aged populations, through a primary questionnaire survey and literature research.

Understanding the mechanism of circadian rhythm of allergic rhinitis will enable us to have a more detailed understanding of the chronology of rhinitis treatment and provide guidance for relieving the symptoms of allergic rhinitis.

DOI: 10.54254/2753-8818/2026.PJ31222

## 2. Literature review

The circadian rhythm is a self-regulating and self-maintaining physiological rhythm that lasts approximately 24 hours and is an important foundation for sleep generation. In the central biological clock, the suprachiasmatic nucleus (SCN) of the hypothalamus serves as its neural centre. When its volume and cell count decrease, the secretion of melatonin at night decreases, thereby affecting the circadian rhythm and leading to clinical symptoms such as insomnia at night.

In addition to the central biological clock, peripheral tissues also have independent rhythmic regulatory systems that can respond to central signals to synchronize their own rhythms [3-5].

Take the immune system as an example. Clock genes and clock-regulating genes control the rhythmic changes of this system. Multiple immune cells (such as eosinophils, mast cells, and T cells) express core clock genes (for instance, the four groups of mammalian clock genes/proteins that form a transcription-translation negative-feedback loop: CLOCK, BMAL1, PER proteins, and CRY proteins), and their immune functions as well as the release of inflammatory mediators exhibit obvious rhythmicity [6]. BMAL1 can directly bind to the promoter regions of target genes, including pro-inflammatory factors and antioxidant factors, thereby regulating the circadian expression of these genes and subsequently influencing the inflammatory response of immune cells [7]. CLOCK achieves the pro-inflammatory effect by directly interacting with components of the NFKB pathway and by forming a complex to exert transcriptional activation. CRYs control the intensity of the immune response by down-regulating inflammatory cytokines and are important anti-inflammatory proteins. Lack of CRY can constitutively activate pro-inflammatory cytokines (such as IL-6, TNF-α) [8].

Studies have shown that the symptoms of some immune-related diseases (such as rheumatoid arthritis, multiple sclerosis, allergic rhinitis, asthma, etc.) have obvious diurnal fluctuation characteristics. A study on 164 healthy subjects exposed to rhinovirus demonstrated that the likelihood of illness in those with insufficient sleep was four times that of normal individuals [9].. Another experiment involving over 50,000 nurses also found that insufficient sleep or poor sleep conditions had a higher risk of pneumonia, Even after adjusting for variables such as age, body mass index and smoking, the incidence rate still did not significantly decrease [9].

### 2.1. The basic mechanism of Allergic Rhinitis (AR)

The pathophysiological mechanism of allergic rhinitis (AR) is rather complex and mainly belongs to type I hypersensitivity mediated by immunoglobulin E (IgE), involving two phases: the early reaction and the late reaction. According to the exposure mode of allergens, it can be divided into inhalation (such as pollen, mites, and animal dander) and contact (such as skin or food) allergies. When an individual is exposed to an allergen for the first time, the body enters a sensitised state; upon subsequent exposure to the same allergen, the antigen will bind to the specific IgE antibodies on the surface of mast cells and basophils, triggering an allergic reaction [10].

The early reaction usually occurs within minutes and is characterised by mast cell degranulation, releasing a large amount of histamine, which is the main cause of acute symptoms such as sneezing, runny nose, nasal itching, and ocular itching, redness, and tearing. At the same time, along with the release of histamine, there are also potent pro-inflammatory mediators such as leukotrienes, prostaglandins, and kinins, which increase vascular permeability and cause nasal mucosa edema.

Late-phase reactions occur within several hours after exposure to the allergen, characterised by the massive recruitment of inflammatory cells (including eosinophils, basophils, neutrophils, T lymphocytes and monocytes) and the release of various inflammatory mediators (such as cytokines,

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prostaglandins and leukotrienes), leading to the persistence of inflammation. This stage often triggers tissue remodelling, further aggravates nasal mucosa edema, and causes persistent nasal congestion, which is one of the most common complaints of patients. With the repeated occurrence of mucosal inflammation, the tissue's reactivity to allergens increases, and may even develop into bronchial hyperresponsiveness. Long-term inflammation not only impairs the quality of life but also seriously affects sleep and daily activities [11,12].

## 2.2. The specific influence of circadian rhythm on allergic rhinitis

The symptoms of allergic rhinitis (AR) exhibit a distinct circadian rhythm. Numerous studies have shown that the symptoms of AR patients (such as sneezing, nasal congestion, and runny nose) are most severe in the early morning, for instance, around 6 a.m. [2]. This rhythmic change is closely related to the multiple physiological mechanisms that regulate circadian rhythms within the body. Histamine release reaches its peak in the early morning. Histamine is an important biological amine, released by mast cells and playing a crucial role in allergic reactions. The plasma histamine level is closely related to the severity of allergic symptoms - the higher the histamine level, the more severe the symptoms. In nocturnal animals such as rats, studies have found that their plasma histamine level reaches its peak at the end of light exposure (i.e., the end of rest) [13]. That is to say, the plasma histamine level in humans is the highest in the early morning, because dawn marks the end of human rest. This is one of the core mechanisms leading to the aggravation of AR symptoms in the early morning.

The cortisol level is the lowest in the early morning, and the anti-inflammatory ability is weakened. Cortisol is a natural glucocorticoid secreted by the adrenal glands, with a powerful anti-inflammatory effect. Its secretion shows a distinct diurnal rhythm, with its level reaching the lowest point between 12 a.m. and 4 a.m., then rising rapidly, and gradually increasing after waking up in the morning, reaching the peak and then gradually decreasing, reaching the lowest point again in the next night, and this cycle repeats [14,1].Therefore, the cortisol level is still relatively low around 6 a.m., at this time the anti-inflammatory ability is weak, and there is a greater likelihood of inflammatory reactions; this is also an important physiological reason for the significant aggravation of AR symptoms in the early morning. As the sun rises, the cortisol level gradually increases, and the symptoms often gradually alleviate in the morning.

Regarding the influence of circadian rhythms on allergic rhinitis (AR), researchers have begun to explore treatment strategies based on biological rhythms, such as chronotherapy. This method aims to enhance treatment efficacy and reduce adverse reactions by coordinating the relationship between drug intervention and the body's physiological rhythms. For instance, studies have shown that administering medication at night is more effective in treating allergic rhinitis compared to administering it in the morning [15]. As the understanding of the role of circadian rhythms in immune regulation and allergic reactions continues to deepen, incorporating circadian clock factors into the thinking of treating allergic diseases also provides new ideas for individualized treatment.

## 2.3. Limitations of current research and future research directions

Existing studies consistently report that allergic rhinitis (AR) symptoms often peak in the early morning, yet most rely on clinical scoring or limited sleep quality measures, without integrating lifestyle and sleep-related variables into a unified framework. Factors such as chronotype, bedtime, sleep duration, and stability of sleep patterns remain under-explored, and little is known about why 20–30% of patients deviate from the typical morning-peak pattern. The potential influence of sleep

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medication on symptom timing or severity is also rarely addressed. There is a lack of comprehensive, patient-reported data that can simultaneously record symptom duration, detailed sleep habits, and medication usage. This study aims to fill this gap and clarify how circadian rhythm-related factors affect AR syndrome, while verifying hypotheses.

## 3. Methodology

This dissertation adopted a combined research method of literature review and questionnaire survey. Firstly, through literature research, a background investigation was conducted on the previous research results related to allergic rhinitis and sleep quality, and a reference questionnaire scale applicable to the research topic was identified. Secondly, the author also employed the questionnaire survey method. A questionnaire mainly concerning the sleep quality and occurrence of allergic rhinitis patients was designed. The primary data for this survey mainly comes from questionnaires. To comprehensively assess the sleep condition, the Pittsburgh Sleep Quality Index (PSQI) was widely adopted in previous study. This scale was developed by Professor Buysee and consists of 19 items and 7 dimensions. It includes sleep quality, sleep duration, sleep duration efficiency, sleep disorders, use of hypnotic drugs, sleep disturbance, and daytime functioning [16]. A comprehensive analysis of sleep was conducted, with Cronbach's alpha being 0.734, indicating high reliability and validity. The experimental data were statistically analysed by assigning scores to the answers. The total score of the scale ranges from 0 to 21, with a total score of ≥8 indicating problems with sleep quality [17]. The higher the score, the worse the sleep quality. In practical research, the sleep quality score and sleep duration are often used as the basis for grouping, such as dividing into "sleep quality ≥8 points" and "<8 points" groups, or "sleep duration <6 hours" and "≥6 hours" groups, to explore the correlation between different sleep states and the studied diseases. Benefiting from the advantages of ease of use and assess-ability of this scale,the author will incorporate it as part of authors questionnaire survey to investigate the sleep quality of patients with rhinitis.

Besides the PSQI, other studies also used the Modified Version of the Adolescent Sleep Hygiene Scale, M-ASHS. This scale has a Cronbach's α of 0.89, indicating high reliability and validity [18]. It is often filled out by both students and their parents, covering indicators related to sleep such as bedtime and wake-up times, nighttime sleep duration, and daytime napping time [18]. By calculating and analysing these indicators, the potential association between AR and sleep was studied.However, since this scale has specific age limitations - for teenagers - the author did not use it as part of the sleep quality assessment in the questionnaire survey.

When assessing the symptoms of AR, the Total Symptom Score (TSS) is often used [19]. This common subjective assessment tool for allergic rhinitis covers multiple core symptoms such as nasal congestion, sneezing, clear nasal discharge, and nasal itching, and is used to comprehensively measure the assessment, has played a central role in the research on the relationship between allergic rhinitis and sleep. Combined with some supplementary scales and the application of TSS and other nasal symptom scoring tools, people have obtained the existing conclusions regarding the relationship between circadian rhythm disorders and allergic rhinitis. The nasal symptom items in the questionnaire were adapted from the "Total Symptom Score (TSS)" scale. The TSS scale facilitates the reliable quantification of symptoms and supports the subsequent analysis of the correlation between symptom severity and sleep quality.

The final questionnaire consisted of 28 questions, including 4 screening questions, 8 questions related to allergic rhinitis and 16 questions about sleep conditions. A total of 58 questionnaires were

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collected, among which 50 were valid and all came from subjects who had been medically diagnosed with allergic rhinitis.

Regarding the search and collection of secondary data, most of the materials can be found on "China National Knowledge Infrastructure" (CNKI) and Google Scholar. The selected literature is all from academic research and has no vested interests, thus having high credibility and presenting a relatively objective picture. The cited papers are mostly published in recent years, making the research topic relatively novel and the content more cutting-edge.

When conducting a comprehensive literature search, keyword searches were performed using the following terms: allergic rhinitis, circadian rhythms, allergic reactions, sleeping quality, and immune symptoms.

## 4. Result

All the questionnaire data of the participants diagnosed with allergic rhinitis were input into SPSS for analysis. Descriptive statistics (mean, standard deviation, frequency and percentage) were used to analyse the onset time of rhinitis symptoms. Participants were divided into the following groups based on their sleep conditions: PSQI score 0-5 for excellent sleep quality, PSQI score 6-10 for fair sleep quality, and PSQI score 11-15 for poor sleep quality. Additionally, participants were classified into two groups based on their circadian rhythm: normal and disrupted, according to their sleep duration, sleep onset time, and difficulty in falling asleep. Correlation analysis, analysis of variance, and other methods were used to study the relationship between sleep quality/circadian rhythm and the severity of rhinitis (total score and individual symptoms), as well as the relationship between age and the severity of rhinitis. Chi-square test was used to examine the relationship between the duration of rhinitis and sleep rhythm and quality. A p-value less than 0.05 was considered statistically significant.

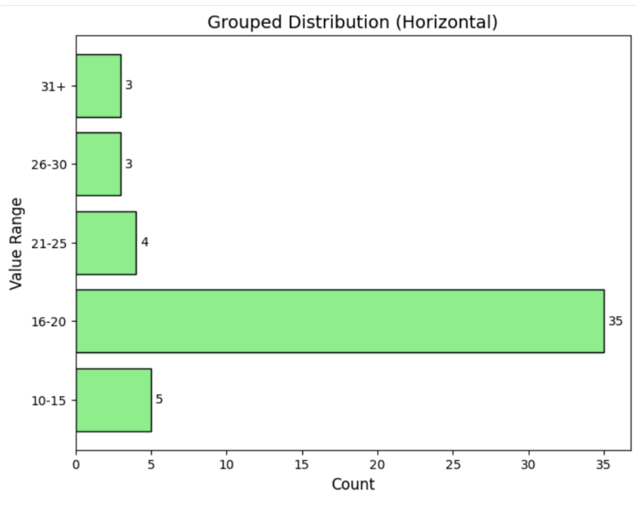


Figure 1. A horizontal bar chart showing the age groups of the participants

According to figure 1,this questionnaire was completed by 50 participants, whose ages ranged from 13 to 48. Among them, the largest number of participants (18 people) were 16 years old, and the majority of the participants were aged between 16 and 20.

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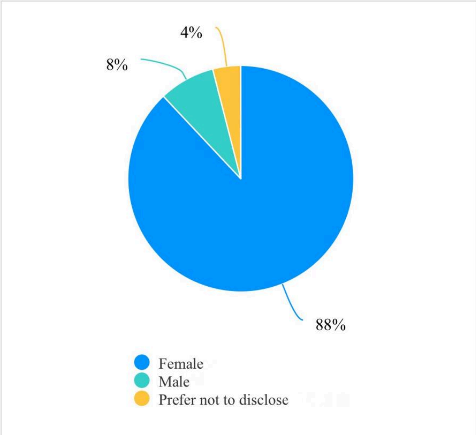


Figure 2. The pie chart presenting the results regarding gender in the questionnaire survey

The gender distribution of the participants shows that women account for the vast majority (88%), while men make up 8%. Additionally, 4% of the participants did not wish to disclose their gender. As shown in Figure 2.

Table 1. Table of questionnarie results on sleep quality and the severity of rhinitis

| Pearson Correlation - Detailed Format | | |
|---|---|---|
| | | PSQI score |
| Allergic rhinitis | Correlation coefficient | 0.410** |
| | p-value | 0.003 |
| | sample size | 50 |
| Frequency of sneezing | Correlation coefficient | 0.310* |
| | p-value | 0.029 |
| | sample size | 50 |
| Severity of nasal congestion | Correlation coefficient | 0.407** |
| | p-value | 0.003 |
| | sample size | 50 |
| Severity of runny nose | Correlation coefficient | 0.262 |
| | p-value | 0.066 |
| | sample size | 50 |
| Itchiness in the nose | Correlation coefficient | 0.262 |
| | p-value | 0.067 |
| | sample size | 50 |
| Impact of rhinitis on your daily activities | Correlation coefficient | 0.290* |
| | p-value | 0.041 |
| | sample size | 50 |

* p<0.05 ** p<0.01

From table 1, it can be seen that this study utilized the correlation analysis method to explore the correlation between the total score of PSQI and the overall severity of rhinitis as well as its various

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components (frequency of sneezing, severity of nasal congestion, severity of runny nose, nasal itching, and impact on daily life). Pearson correlation coefficient was used to indicate the strength of the correlation. The results showed that the correlation coefficient between the total score of PSQI and the total score of rhinitis symptoms was 0.410, and the P value was less than 0.01. Thus, it indicates that there is a significant positive correlation between the total score of PSQI and the score of rhinitis symptoms, suggesting that the worse the sleep quality, the more severe the rhinitis symptoms. Among them, the correlation coefficient between the total score of PSQI and the frequency of sneezing was 0.310, and the P value was 0.029, which was less than the standard 0.05, indicating a significant positive correlation between the two. The correlation coefficient between the total score of PSQI and the severity of nasal congestion was 0.407, and the P value was 0.003, which was much less than 0.01, indicating the same significant positive correlation. The correlation between PSQI and the impact of rhinitis on daily activities was 0.290 ($p = 0.041$). Although this reached statistical significance, the effect size was below 0.3, indicating only a very weak association that may have limited practical relevance. Comparing these three symptoms, the severity of nasal congestion symptoms has the strongest correlation with sleep quality.

It should be noted that some variables in this study did not show significant correlations (such as severity of runny nose and nasal itching), which may be related to the limited sample size (only 50 questionnaires). Due to the small sample size, the statistical power is limited, which may prevent the true existing correlations from being statistically manifested. Therefore, after expanding the sample size, these relationships may become significant correlations. From the perspective of research hypotheses, the correlations between these specific symptoms and sleep quality still have a relatively high possibility of being valid.

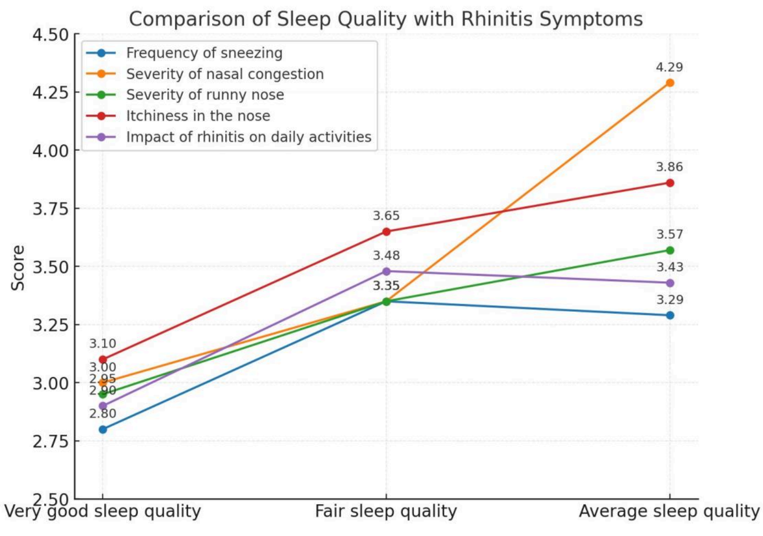


Figure 3. Graph of questionnaire results on the comparison of sleep quality with rhinitis symptoms

As shown in Figure 3, this study further employed the method of variance analysis. According to the PSQI reference standard, the subjects were divided into three groups (average sleep quality, very good sleep quality, and fair sleep quality), and the scores of each rhinitis symptom dimension in different groups were compared. As can be seen from the figure, whether it is the frequency of sneezing, nasal congestion, runny nose, nasal itching, or the impact of rhinitis on daily life, the severity of symptoms in the group with good sleep quality (PSQI < 5) was at the lowest level; while in the group with average or poor sleep quality, the scores of these symptoms were significantly higher. The trend of the line graph directly indicates that there is a consistent positive relationship

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between sleep quality and the severity of rhinitis symptoms, that is, the worse the sleep quality, the more severe the manifestation of rhinitis symptoms. This result further supplements and verifies the aforementioned correlation analysis.

Table 2. Table of questionnarie results on the duration of rhinitis and sleep quality

| Pearson Correlation - Detailed Format | | |
|---|---|---|
| | | Duration of rhinitis |
| sleep quality | Correlation coefficient | 0.326* |
| | p-value | 0.021 |
| | sample size | 50 |
| * p<0.05 ** p<0.01 | | |

The data in table 2 shows that the correlation coefficient is 0.326, and the p-value is less than 0.05. This indicates a positive correlation between the duration of rhinitis and sleep quality. It was found that as the duration of rhinitis increased, the sleep quality score (PSQI score) of the subjects showed an upward trend, suggesting that the duration of rhinitis has a significant impact on sleep quality. Long-term patients with rhinitis are more likely to experience a decline in sleep quality.

Table 3. Table of questionnarie results on circadian rhythm and the severity of rhinitis

| Pearson Correlation - Detailed Format | | | | |
|---|---|---|---|---|
| | | Hours actually sleep on average each day | Minutes does it usually take you to fall asleep after getting into bed | On average, time that you go to bed every day |
| Frequency of sneezing | Correlation coefficient | 0.119 | 0.002 | 0.209 |
| | p-value | 0.410 | 0.988 | 0.146 |
| | sample size | 50 | 50 | 50 |
| Severity of nasal congestion | Correlation coefficient | -0.164 | 0.131 | 0.185 |
| | p-value | 0.254 | 0.364 | 0.198 |
| | sample size | 50 | 50 | 50 |
| Severity of runny nose | Correlation coefficient | 0.219 | 0.215 | 0.027 |
| | p-value | 0.126 | 0.133 | 0.853 |
| | sample size | 50 | 50 | 50 |
| Itchiness in the nose | Correlation coefficient | 0.065 | 0.257 | 0.168 |
| | p-value | 0.654 | 0.071 | 0.244 |
| | sample size | 50 | 50 | 50 |
| Impact of rhinitis on your daily activities | Correlation coefficient | -0.130 | 0.269 | 0.095 |
| | p-value | 0.367 | 0.059 | 0.510 |
| | sample size | 50 | 50 | 50 |

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Table 3. (continued)

| | | | | |
|---|---|---|---|---|
| Allergic rhinitis | Correlation coefficient | 0.023 | 0.244 | 0.186 |
| | p-value | 0.875 | 0.087 | 0.197 |
| | sample size | 50 | 50 | 50 |
| * p<0.05 ** p<0.01 | | | | |

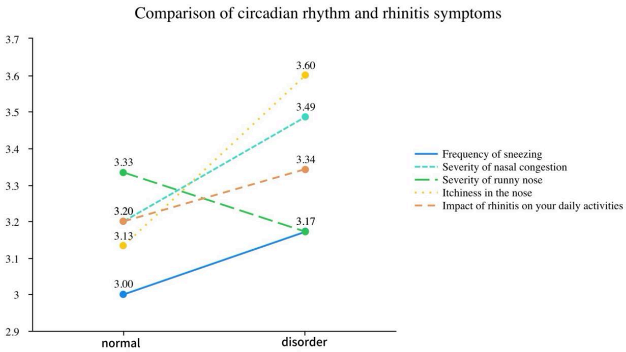


Figure 4. Graph of questionnaire results on the comparison of circadian rhythm with rhinitis symptoms

In table 3 the Pearson correlation analysis results showed that although the statistical significance did not reach the threshold ($p < 0.05$), from the perspective of the correlation coefficient, there was a certain trend of association between the circadian rhythm indicators and the symptoms of rhinitis. Specifically, first, the duration of sleep was negatively correlated with most of the nasal allergy symptoms (severity of nasal congestion $r = -0.164$, impact on daily life $r = -0.130$), suggesting that an increase in sleep time may alleviate the symptoms. Second, the correlation coefficients between the difficulty of falling asleep and various nasal allergy symptoms and the overall degree of nasal allergy ranged from 0.002 to 0.269, showing a positive correlation. Especially, the correlation trend with the impact on daily life was the strongest, with $r = 0.269$, $p = 0.059$, which was close to being significant. This indicates that the more difficult it is to fall asleep, the more severe the nasal allergy symptoms may be. Third, bedtime also had a positive correlation with various nasal allergy symptoms, with r ranging from 0.027 to 0.209. This suggests that people who go to bed late may have more frequent and severe symptoms. This is consistent with the initial hypothesis that circadian rhythm disorders may exacerbate nasal allergy symptoms.

The results of the variance analysis (Figure 4) further support this pattern. Except for runny nose, the symptom scores of the circadian rhythm disorder group were much higher than those of the normal rhythm group for all items, with the most significant difference being in nasal itching (3.60 vs 3.13). Therefore, due to the limited sample size (50 samples), the statistical power is insufficient.

Although no significant differences were detected, considering the trend and theoretical inference, there is still a reason to believe that there is a correlation between circadian rhythm disorders and the severity of nasal allergy, and it is worth further verification in a larger sample.

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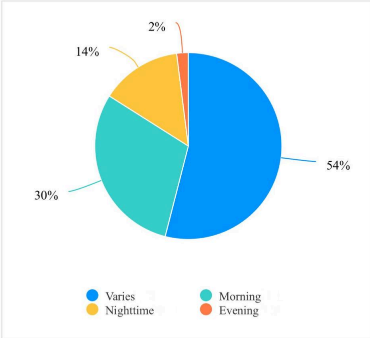


Figure 5. Pie chart of the questionnaire results for the worth rhinitis symptom times

According to the results of the questionnaire survey, 54% of patients with allergic rhinitis (AR) indicated that the onset time of their symptoms was not consistent ('Varies'), but 30% of the patients still believed that the morning was the period when their symptoms were the most severe. This can largely confirm the author's previous assumption that most AR patients have the most severe symptoms upon waking up in the morning. Additionally, the nighttime (14%) and evening (2%) accounted for relatively lower proportions. Figure 5 shows this distribution clearly.

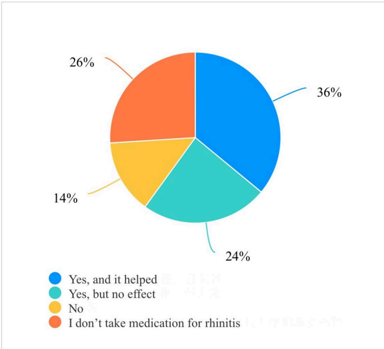


Figure 6. Pie chart of the questionnarie results for the effect in adjusting the medication duration

Of note, when the survey question was asked Have you ever tried adjusting your medication timing (e.g., taking it at night)? Did it help? This change was considered effective by 36% of all responses - a significantly higher percentage than with other options (e.g., "ineffective" or "not tried"), suggesting that dosing schedule modification may be a feasible strategy to improve symptom management. As shown in figure 6.

## 5. Discussion

In this study, the author found that sleep quality was significantly positively correlated with the severity of allergic rhinitis (AR) symptoms, especially in nasal congestion and sneezing. Although the correlation between sleep rhythm-related indicators (e.g., time to fall asleep, difficulty falling asleep, and sleep duration) and rhinitis symptoms did not reach statistical significance ($p < 0.05$), the overall trend showed that sleep rhythm disorder would worsen rhinitis symptoms. These results as a whole support the original hypothesis that circadian disruption and decreased sleep quality worsen rhinitis.

The results of the questionnaire survey were generally consistent with the existing literature. For example, Carlos et al. [9] showed that insufficient sleep and decreased sleep quality significantly increased the risk of immune-related diseases, which is consistent with the finding that rhinitis symptoms were more severe in subjects with poor sleep quality or sleep rhythm disturbances.

In addition, the observed worsening of symptoms in some subjects in the early morning of this study is also highly consistent with the epidemiological findings of "allergic rhinitis symptoms peak in the morning" reported by Reinberg et al. [2] and Nakamura [13] and "symptoms are most severe before the end of the rest period". Although the association between circadian indicators and rhinitis symptoms did not reach statistical significance in this study, this result is most likely due to the limited sample size and insufficient statistical power. From the perspective of theoretical mechanisms and trend observation, this study not only validates the existing research results, but also further emphasizes the importance of subjective sleep quality acting together with circadian rhythm in allergic reactions.

More recently, Hang Li et al. [20] further demonstrated that the temporal variation in the severity of allergic rhinitis symptoms is mediated by circadian rhythms, and emphasized chronotherapy - a drug management strategy that aligns with biological rhythms - as a promising approach for optimizing treatment outcomes. In the context of allergen immunotherapy (AIT), previous studies have shown that the treatment effect has a significant temporal dependence. For example, in an egg protein-induced allergic rhinitis model, the effect of sublingual immunotherapy (SLIT) given in the morning was better than that given in the evening. The results of this study are highly consistent with this, not only observing that the severity of symptoms is closely related to sleep quality and circadian rhythm disorders, but also finding that some patients showed improved treatment responses after adjusting the medication time to the morning. This further confirms the potential value of chronotherapy in the management of allergic rhinitis.

Furthermore, the research conducted by Ohdo et al. [21] indicates that time therapy is particularly applicable when the risk and/or intensity of disease symptoms show predictable changes over time. This situation is quite common in diseases such as allergic rhinitis. The results of this study are consistent with this viewpoint, suggesting that better outcomes can be achieved after changing the medication timing. This also indicates that time therapy has potential value in the management of allergic rhinitis.

## 6. Conclusion

This study aims to explore the impact of circadian rhythm disorders on allergic diseases, with a particular focus on allergic rhinitis. The results show that sleep quality is significantly positively correlated with the severity of allergic rhinitis symptoms, while the relationship between circadian rhythm and symptom severity, although not statistically significant, shows a certain trend. Additionally, this study also found that allergic rhinitis occurs more frequently in the morning. These findings are consistent with the results of existing literature.

It is worth noting that this study is the first to systematically verify the significant positive correlation between sleep quality and the severity of rhinitis symptoms in the young population, and has proposed a new observation: the course of rhinitis may be related to the decline in sleep quality. Through questionnaire surveys, it was also found that some patients can alleviate symptoms by adjusting the medication time, providing practical evidence for individualized treatment based on time and circadian therapy. Although this study is limited by a small sample size and methodological constraints, it still provides valuable empirical evidence for understanding the relationship between sleep quality, circadian rhythm, and allergic rhinitis. Future research should conduct longitudinal studies in larger and more diverse populations and combine objective physiological indicators to provide more references for clinical individualized treatment and chronotherapy.

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