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Assessment Of Knowledge, Attitude and Practice on Chronopharmacology Among the Clinical Doctors in A Tertiary Care Hospital – A Cross-Sectional Study

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ABSTRACT

Background: Chronopharmacology is an emerging field that studies the influence of biological rhythms on the pharmacokinetics and pharmacodynamics of drugs. Circadian rhythms affect various physiological processes and disease patterns, which in turn influence the therapeutic response and safety profile of medications. Understanding the optimal timing of drug administration can improve treatment outcomes and minimize adverse effects. However, awareness and application of chronopharmacological principles among clinicians remain variable.
Aim: To assess the knowledge, attitude, and practice regarding chronopharmacology among clinicians working in a tertiary care hospital.
Methods: The present study was a cross-sectional, descriptive questionnaire-based survey conducted among 110 clinical doctors working in Government General Hospital, Machilipatnam, Andhra Pradesh. A pre-validated structured questionnaire was distributed through Google Forms after obtaining approval from the Institutional Ethics Committee. The questionnaire assessed clinicians' knowledge, attitude, and practice related to chronopharmacology. Data were analyzed using descriptive statistics and p-values were calculated to determine statistical significance.
Results: Among 110 clinicians, 65.5% were aware of chronopharmacology, and 61.8% recognized that drug efficacy can vary according to the timing of administration. A majority (67.3%) believed that chronopharmacology improves therapeutic outcomes, and 74.5% supported its inclusion in clinical guidelines. However, only 49.1% reported routinely considering the timing of drug administration while prescribing medications. Clinicians with greater clinical experience showed better implementation of chronopharmacological principles.
Conclusion: Although clinicians demonstrated a positive attitude toward chronopharmacology, gaps remain in knowledge and practical application. Enhancing awareness through medical education and training programs may improve rational drug therapy and optimize patient outcomes.

Keywords: *Chronopharmacology, Chronotherapy, Circadian rhythm, Knowledge-Attitude-Practice, Clinicians, Drug timing.*

INTRODUCTION

Chronopharmacology is an emerging discipline that studies the interaction between biological rhythms and the pharmacokinetics as well as pharmacodynamics of medications. Human physiological functions follow circadian rhythms, which are approximately 24-hour cycles regulated by the suprachiasmatic nucleus of the hypothalamus. These rhythms influence various physiological processes such as hormone secretion, gastric motility, blood pressure, heart rate, renal function, and hepatic metabolism. As a result, the therapeutic efficacy and toxicity of many medications may vary

depending on the time of administration. Understanding these rhythmic variations forms the basis of chronopharmacology and plays a crucial role in optimizing drug therapy and improving patient outcomes. [1]

The concept of circadian rhythm in medicine has gained increasing attention over the past few decades. Many diseases, including hypertension, asthma, peptic ulcer disease, arthritis, and myocardial infarction, demonstrate circadian variation in their symptoms and severity. For instance, bronchial asthma symptoms are often worse during the night, while blood pressure typically peaks in the early morning hours. Consequently, administering medications at specific times can enhance therapeutic benefits and reduce adverse effects. This time-dependent drug administration is referred to as chronotherapy and represents an important clinical application of chronopharmacology. [2]

Pharmacokinetic processes such as absorption, distribution, metabolism, and excretion are influenced by circadian rhythms. Gastric emptying, hepatic enzyme activity, renal blood flow, and plasma protein binding may fluctuate throughout the day, thereby affecting drug concentration and response. Similarly, pharmacodynamic responses, including receptor sensitivity and tissue responsiveness, may vary depending on the biological clock. These variations highlight the importance of considering the timing of drug administration when prescribing medications to achieve optimal therapeutic outcomes. [3] Several clinical studies have demonstrated the benefits of chronotherapeutic approaches in various medical conditions. Antihypertensive drugs administered at bedtime have been shown to improve blood pressure control and reduce cardiovascular risk compared with morning dosing. Likewise, administering corticosteroids in the early morning can mimic physiological cortisol secretion and minimize adrenal suppression. Chemotherapeutic agents and anti-inflammatory medications have also shown improved efficacy and reduced toxicity when given according to circadian rhythms. These findings emphasize the clinical relevance of chronopharmacology in modern medical practice. [4]

Despite growing evidence supporting chronopharmacology, its practical application in routine clinical settings remains limited. One of the key reasons is the lack of awareness and adequate knowledge among healthcare professionals, particularly clinicians responsible for prescribing medications. Many doctors may not be familiar with the concept of circadian drug response or may not consider the timing of medication administration while making therapeutic decisions. This gap between scientific evidence and clinical practice highlights the need to assess the knowledge, attitude, and practice (KAP) related to chronopharmacology among medical professionals. [5]

Knowledge regarding chronopharmacology is essential for clinicians because it enables them to tailor treatment regimens according to the body's biological rhythms. A positive attitude toward chronotherapy can further facilitate its integration into routine clinical practice, while appropriate prescribing behavior reflects effective implementation. Assessing these three domains—knowledge, attitude, and practice—can help identify existing gaps in understanding and application of chronopharmacological principles among doctors working in tertiary care settings. [6]

Tertiary care hospitals often manage patients with complex medical conditions requiring multiple medications. In such settings, optimizing drug therapy through time-based administration may significantly improve treatment outcomes and reduce adverse drug reactions. Moreover, clinicians working in tertiary hospitals play a key role in guiding medical students and junior doctors; therefore, their understanding and acceptance of chronopharmacology can influence future prescribing practices. [7]

Several international studies have evaluated the awareness and perception of chronopharmacology among healthcare professionals and have reported varying levels of knowledge and implementation. Many studies indicate that although clinicians acknowledge the importance of biological rhythms in disease management, only a limited proportion actively apply chronotherapeutic principles in their daily practice. Educational interventions, clinical guidelines, and continuing medical education programs have been suggested as strategies to improve awareness and utilization of chronopharmacology in healthcare settings. [8]

Assessing clinicians' knowledge, attitude, and practice regarding chronopharmacology is therefore important to identify educational needs and barriers to implementation. Such assessments can help healthcare institutions develop targeted training programs and encourage evidence-based prescribing practices. Ultimately, integrating chrono pharmacological principles into routine clinical care may enhance therapeutic efficacy, reduce adverse effects, and improve overall patient outcomes. [9]

In this context, the present study aims to evaluate the knowledge, attitude, and practice related to Chronopharmacology among clinical doctors working in a tertiary care hospital. Understanding the current level of awareness and application of chrono pharmacological concepts will provide valuable insights for improving medical education and promoting rational drug therapy. [10]

The present study aims to evaluate the level of awareness and implementation of Chronopharmacology among clinicians working in a tertiary care hospital. The objectives of the study are to assess the knowledge of clinicians regarding the basic

concepts and clinical importance of Chronopharmacology , to evaluate their attitude toward the role of biological rhythms in drug therapy and patient management, and to examine their current prescribing practices related to the timing of medication administration in clinical settings. Understanding these aspects will help identify gaps in awareness and utilization of chrono pharmacological principles and may contribute to improving rational drug therapy and patient outcomes through time-based medication strategies.

MATERIAL AND METHODS

The present study is a cross – sectional descriptive study- questionnaire based assessment.

Study site: The study is conducted at Government General Teaching Hospital, Machilipatnam, Krishna district, Andhra Pradesh.

Study population: The population are clinical doctors of either gender who are working in Government General Hospital, Machilipatnam.

Study design: This was a cross-sectional, descriptive survey, conducted through pre-validated structured based questionnaire.

Sample Size: Sample size was rounded to 110 clinical doctors working in the tertiary care hospital.

Study procedure:A pre-validated questionnaire is given in Google forms to the clinicians after taking ethical approval from the Institutional ethical committee.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The unpaired t-test was used to compare continuous variables between independent groups, and the paired t-test was applied for within-group comparisons. Categorical variables were analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

RESULT

Table 1. Demographic Characteristics of the Clinicians (n = 110)

Variable	Category	Number (n)	Percentage (%)	p value
Age Group	<30 years	32	29.1	0.041
	30–40 years	48	43.6	
	>40 years	30	27.3	
Gender	Male	64	58.2	0.118
	Female	46	41.8	
Years of Experience	<5 years	36	32.7	0.036
	5–10 years	40	36.4	
	>10 years	34	30.9	

Table 2. Knowledge Regarding Chronopharmacology Among Clinicians

Knowledge Variable	Yes n (%)	No n (%)	p value
Heard about Chronopharmacology	72 (65.5)	38 (34.5)	0.021
Aware that drug efficacy varies with time of administration	68 (61.8)	42 (38.2)	0.032
Knowledge about circadian rhythm affecting drug metabolism	64 (58.2)	46 (41.8)	0.044
Awareness of chronotherapy in hypertension/asthma	59 (53.6)	51 (46.4)	0.048

Table 3. Attitude Towards Chronopharmacology Among Clinicians

Attitude Statement	Agree n (%)	Neutral n (%)	Disagree n (%)	p value
Chronopharmacology improves therapeutic outcomes	74 (67.3)	20 (18.2)	16 (14.5)	0.018
Timing of drug administration should be considered during prescribing	70 (63.6)	24 (21.8)	16 (14.6)	0.026
Chronopharmacology should be included in clinical guidelines	82 (74.5)	16 (14.5)	12 (10.9)	0.009

Table 4. Practice of Chronopharmacology Among Clinicians

Practice Variable	Yes n (%)	No n (%)	p value

Consider timing while prescribing medications	54 (49.1)	56 (50.9)	0.062
Prescribe bedtime antihypertensive medications	48 (43.6)	62 (56.4)	0.048
Advise patients regarding correct timing of medication	58 (52.7)	52 (47.3)	0.037

Table 5. Overall, Knowledge Score Among Clinicians

Knowledge Level	Number (n)	Percentage (%)	p value
Poor knowledge	26	23.6	0.029
Moderate knowledge	48	43.6	
Good knowledge	36	32.7	

Table 6. Association Between Years of Experience and Practice of Chronopharmacology

Years of Experience	Good Practice n (%)	Poor Practice n (%)	p value
<5 years	14 (38.9)	22 (61.1)	0.031
5–10 years	21 (52.5)	19 (47.5)	
>10 years	23 (67.6)	11 (32.4)	

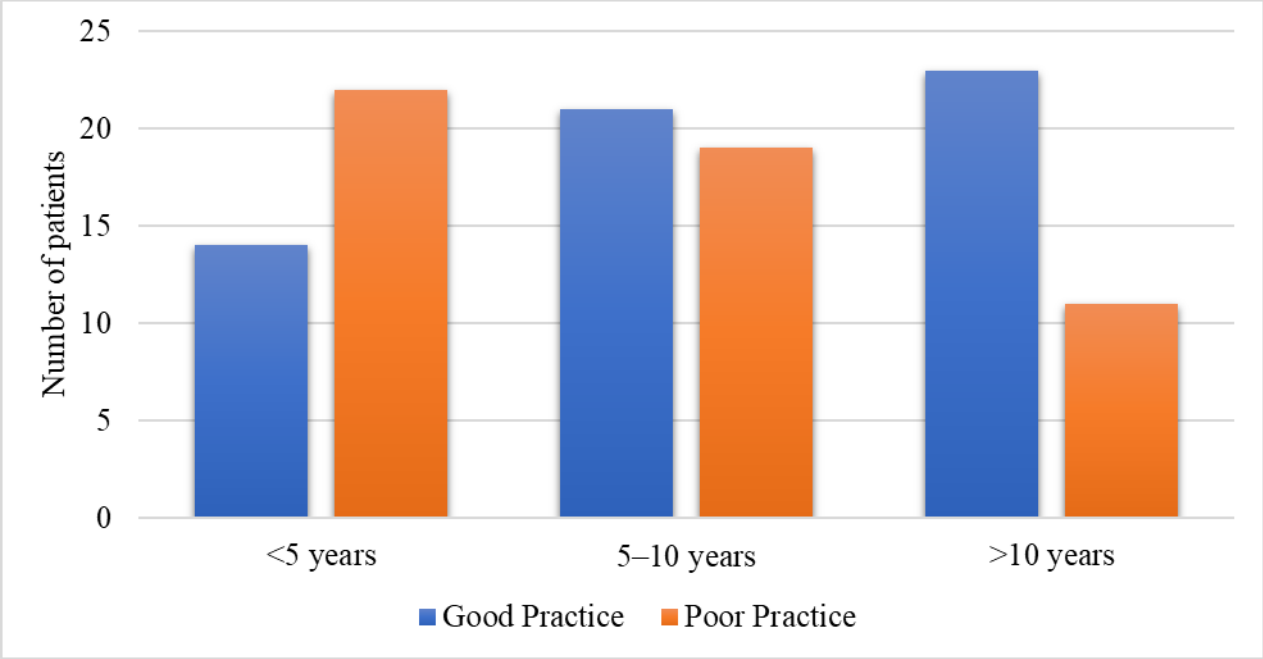

Figure: 1. Association Between Years of Experience and Practice of Chronopharmacology

Table 1: Demographic Characteristics of the Clinicians

A total of 110 clinical doctors participated in the study. The majority of participants belonged to the age group of 30–40 years (48, 43.6%), followed by those aged <30 years (32, 29.1%) and >40 years (30, 27.3%). Male clinicians constituted 64 (58.2%) of the participants, while females accounted for 46 (41.8%). Regarding years of professional experience, 40 (36.4%) clinicians had 5–10 years of experience, 36 (32.7%) had less than 5 years of experience, and 34 (30.9%) had more than 10 years of experience. The association between demographic variables and awareness showed statistical significance for age group ($p = 0.041$) and years of experience ($p = 0.036$), whereas gender did not show a statistically significant association ($p = 0.118$).

Table 2: Knowledge Regarding Chronopharmacology Among Clinicians

The assessment of knowledge revealed that 72 (65.5%) clinicians had heard about chronopharmacology, while 38 (34.5%) had no prior knowledge of the concept ($p = 0.021$). About 68 (61.8%) participants were aware that drug efficacy may vary depending on the time of administration, whereas 42 (38.2%) were unaware of this relationship ($p = 0.032$). Similarly, 64 (58.2%) clinicians knew that circadian rhythm could influence drug metabolism, while 46 (41.8%) lacked this knowledge ($p = 0.044$). Awareness regarding the application of chronotherapy in diseases such as hypertension and asthma was observed in 59 (53.6%) clinicians, whereas 51 (46.4%) were not aware of this application ($p = 0.048$).

Table 3: Attitude Towards Chronopharmacology Among Clinicians

With regard to attitude, 74 (67.3%) clinicians agreed that chronopharmacology could improve therapeutic outcomes, 20 (18.2%) were neutral, and 16 (14.5%) disagreed with the statement ($p = 0.018$). A majority of 70 (63.6%) participants believed that the timing of drug administration should be considered during prescribing, while 24 (21.8%) were neutral

and 16 (14.6%) disagreed (p = 0.026). Furthermore, 82 (74.5%) clinicians supported the inclusion of chronopharmacology concepts in clinical guidelines, whereas 16 (14.5%) were neutral and 12 (10.9%) disagreed with this view, showing a statistically significant difference (p = 0.009).

Table 4: Practice of Chronopharmacology Among Clinicians
Assessment of clinical practice showed that 54 (49.1%) clinicians reported considering the timing of drug administration while prescribing medications, whereas 56 (50.9%) did not routinely consider it (p = 0.062). Regarding bedtime dosing of antihypertensive drugs, 48 (43.6%) clinicians reported prescribing them at night, while 62 (56.4%) did not follow this practice (p = 0.048). In addition, 58 (52.7%) clinicians reported advising patients about the correct timing of medication intake, whereas 52 (47.3%) did not regularly provide such instructions (p = 0.037).

Table 5: Overall Knowledge Score Among Clinicians
Overall knowledge assessment indicated that 26 (23.6%) clinicians had poor knowledge regarding chronopharmacology, while 48 (43.6%) had moderate knowledge and 36 (32.7%) demonstrated good knowledge. The distribution of knowledge levels among clinicians was statistically significant (p = 0.029), indicating variability in awareness of chronopharmacological principles among the participants.

Table 6: Association Between Years of Experience and Practice of Chronopharmacology
The association between years of clinical experience and chronopharmacology practice revealed that among clinicians with less than 5 years of experience, 14 (38.9%) demonstrated good practice while 22 (61.1%) showed poor practice. Among those with 5–10 years of experience, 21 (52.5%) had good practice and 19 (47.5%) had poor practice. In clinicians with more than 10 years of experience, 23 (67.6%) demonstrated good practice while 11 (32.4%) had poor practice. This association was statistically significant (p = 0.031), suggesting that clinicians with greater professional experience were more likely to apply chronopharmacological principles in clinical practice.

DISCUSSION

The present study assessed the knowledge, attitude, and practice (KAP) regarding chronopharmacology among clinicians working in a tertiary care hospital. The findings of the present study revealed that although a considerable proportion of clinicians had heard about chronopharmacology and were aware that drug efficacy may vary with the timing of administration, gaps in knowledge and practical implementation still existed. In the current study, about two-thirds of clinicians were aware of chronopharmacology and more than half recognized that circadian rhythms influence drug metabolism and therapeutic response. These findings highlight that while basic awareness exists among clinicians, the depth of knowledge and routine clinical application of chronotherapeutic principles remain limited. Similar findings were reported by Pichholiya et al. [11], who conducted a questionnaire-based study among resident doctors and observed that although clinicians recognized the importance of chronotherapy in clinical practice, detailed knowledge regarding the optimal timing of different medications was inadequate.

In the present study, clinicians demonstrated a generally positive attitude toward chronopharmacology. A majority agreed that considering the timing of drug administration could improve therapeutic outcomes and supported the inclusion of chronopharmacological concepts in clinical guidelines. These results are consistent with the findings of another cross-sectional study conducted in a tertiary care hospital, which reported that most doctors believed chronotherapy could improve drug efficacy and reduce adverse drug reactions. The same study also emphasized that clinicians supported the integration of chronopharmacology into pharmacology references and clinical practice guidelines. Such findings indicate that healthcare professionals are receptive to the concept of time-dependent drug therapy and recognize its potential benefits for patient care.

However, despite the favorable attitude observed in the present study, the practical implementation of chronopharmacology among clinicians was relatively limited. Only about half of the clinicians reported routinely considering the timing of drug administration while prescribing medications. This observation is in agreement with the study conducted by Pichholiya et al. [12], which found that although resident doctors were aware of chronotherapeutic principles, their actual prescribing practices were not consistently aligned with circadian rhythms. The authors suggested that insufficient formal training in chronopharmacology during medical education may contribute to this gap between knowledge and practice.

Comparable observations were reported in a study conducted among healthcare professionals in a tertiary care teaching institute in South Rajasthan. The investigators found that a large proportion of clinicians had never heard the specific terms “chronopharmacology” or “chronotherapeutics,” despite many of them unknowingly prescribing medications according to biological rhythms. The study also demonstrated that clinicians acknowledged the importance of drug-timing strategies and expressed willingness to incorporate chronotherapy principles into clinical practice and medical education. These findings suggest that clinicians may intuitively recognize the clinical relevance of drug timing even when they are not formally trained in chronopharmacology.

Another questionnaire-based study assessing doctors' awareness and behavior regarding chronopharmacology also reported similar results. The authors found that although many physicians were able to correctly identify appropriate timing for certain medications such as statins at night or antihypertensive drugs in the morning, there were still considerable knowledge gaps regarding the optimal timing for several other drugs. The study concluded that while clinicians generally had a favorable perception of chronotherapy, their understanding of specific chronopharmacological principles remained incomplete.

The association between years of clinical experience and the practice of chronopharmacology observed in the present study suggests that clinicians with greater experience were more likely to apply time-based prescribing practices. This may be attributed to the accumulation of clinical observations and experience in managing diseases with circadian variation, such as hypertension, asthma, and peptic ulcer disease. Similar conclusions were drawn by earlier studies, which reported that experienced clinicians were more likely to recognize the clinical importance of drug-timing strategies and incorporate them into patient management.

Overall, the findings of the present study are consistent with previously published literature indicating that although clinicians have a positive perception of chronopharmacology, there remains a significant gap between theoretical knowledge and its application in routine clinical practice. Improving awareness through continuing medical education programs, incorporation of chronopharmacology into undergraduate and postgraduate medical curricula, and inclusion of drug-timing recommendations in clinical guidelines may help bridge this gap and promote rational drug therapy.

CONCLUSION

The present study assessed the knowledge, attitude, and practice regarding chronopharmacology among clinicians working in a tertiary care hospital. The findings revealed that although a considerable proportion of clinicians were aware of chronopharmacology and recognized the importance of circadian rhythms in drug therapy, gaps still existed in detailed knowledge and practical implementation. Most clinicians demonstrated a positive attitude toward the concept and acknowledged that appropriate timing of drug administration can improve therapeutic outcomes and reduce adverse drug reactions. However, only about half of the clinicians reported routinely applying chronopharmacological principles in their prescribing practices. The study also indicated that clinicians with greater years of professional experience were more likely to incorporate time-based medication strategies into clinical practice. These findings highlight the need for enhanced awareness and training on chronopharmacology through continuing medical education programs and inclusion in medical curricula. Improving clinicians' knowledge and practice of chronotherapy may ultimately contribute to more rational drug therapy and improved patient outcomes.

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