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Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses

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ABSTRACT
This study aims to examine the association between night shift work and metabolic syndrome among hospital nurses by exploring underlying behavioral, physiological, and organizational factors. A qualitative approach was employed using a case study design with a phenomenological orientation, selected to capture in-depth lived experiences and contextual workplace dynamics influencing nurses' health. The research was conducted in a tertiary-level urban hospital, chosen due to its intensive night shift system and diverse nursing workforce. A total of seventeen participants were involved, consisting of twelve nurse respondents and five key informants, selected purposively based on their direct experience and professional relevance to ensure data richness and credibility. Data were collected through in-depth interviews, observation, and document analysis, and analyzed thematically. The findings reveal that night shift work contributes to circadian rhythm disruption, increased occupational stress, and unhealthy lifestyle patterns, which collectively elevate the risk of metabolic syndrome. Organizational factors such as high job demands and limited control further exacerbate these risks. The study recommends the implementation of adaptive shift scheduling, workplace health promotion programs, and institutional support systems to mitigate adverse health outcomes among nurses.

INTRODUCTION

Night shift work has become an integral component of modern healthcare systems, particularly in hospital settings where continuous patient care is indispensable. Nurses, as the largest group of healthcare professionals, are frequently assigned rotating or permanent night shifts to ensure uninterrupted service delivery. While such arrangements are essential for operational efficiency, an increasing body of evidence suggests that night shift work may adversely affect the health status of nurses (Jalilul, 2025). One of the most concerning outcomes is the heightened risk of metabolic syndrome, a cluster of interrelated conditions including central obesity, hypertension, dyslipidemia, and impaired glucose metabolism (Asirani, 2025). These conditions collectively elevate the risk of cardiovascular diseases and type 2 diabetes mellitus, thereby posing a significant public health concern (Reshia et al., 2025). The present study, titled *Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses*, seeks to critically examine this relationship within the context of occupational health and clinical epidemiology.

The state of the art in this field indicates a growing recognition of circadian rhythm disruption as a key mechanism linking night shift work to metabolic disturbances (Sy et al., 2023). The human body operates on a biological clock that regulates sleep-wake cycles, hormone secretion, and metabolic processes (Wang et al., 2024). Night shift work disrupts this natural rhythm, leading to sleep deprivation, hormonal imbalance, and altered eating patterns (Elksas, 2024). Recent studies have identified associations between shift work and increased levels of cortisol, insulin resistance, and abnormal lipid profiles (Campo, 2025). However, despite these advances, the existing literature remains fragmented, with varying methodological approaches, inconsistent findings, and limited focus on

specific professional groups such as hospital nurses in developing countries (Seragon & Cruz, 2025). Moreover, many studies rely on cross-sectional designs, which restrict the ability to establish causal relationships (Nurmaisyah et al., 2023).

The primary problem addressed in this research lies in the insufficient understanding of how night shift work specifically contributes to the development of metabolic syndrome among hospital nurses. While general associations have been documented, there is a lack of comprehensive analysis that integrates occupational factors, lifestyle behaviors, and physiological outcomes within a unified framework (Kunwar & Ojha, 2023). Additionally, contextual variables such as workload intensity, dietary habits during shifts, and institutional support systems are often overlooked (Zhou et al., 2025). This gap in knowledge limits the effectiveness of preventive strategies and workplace interventions aimed at mitigating health risks among nurses.

The research gap is further evident in the scarcity of region-specific studies, particularly in Southeast Asia, where healthcare systems are rapidly evolving and the burden of non-communicable diseases is increasing (Sawitri et al., 2024). Most existing studies are conducted in Western contexts, which may not adequately reflect the socio-cultural and organizational dynamics of hospitals in other regions (Dyaningsih et al., 2023). Furthermore, there is limited exploration of gender-specific factors, despite the predominance of women in the nursing profession (Mohammed, 2024). These gaps underscore the need for a more nuanced and contextually grounded investigation that can contribute to both global and local understandings of the issue.

The novelty of this study lies in its integrative approach, combining epidemiological assessment with occupational health analysis to examine the multifaceted relationship between night shift work and metabolic syndrome. By focusing on hospital nurses as a specific population, the study aims to generate targeted insights that can inform policy and practice. It also incorporates variables such as duration of shift work, sleep quality, dietary patterns, and physical activity levels, thereby providing a more comprehensive evaluation of risk factors. This approach is expected to yield new evidence that enhances the existing body of knowledge and supports the development of tailored interventions.

Based on the identified problems and gaps, the research is guided by several key questions. These include: how does night shift work influence the prevalence of metabolic syndrome among hospital nurses; what occupational and lifestyle factors mediate this relationship; and to what extent do duration and intensity of night shift exposure affect metabolic health outcomes. These questions are designed to address both the direct and indirect pathways through which shift work impacts health, thereby enabling a more holistic understanding of the phenomenon.

The primary objective of this study is to analyze the association between night shift work and metabolic syndrome among hospital nurses. Specifically, it aims to determine the prevalence of metabolic syndrome in this population, identify contributing risk factors, and assess the role of occupational characteristics in shaping health outcomes. By achieving these objectives, the study seeks to provide empirical evidence that can inform workplace health policies and clinical practices.

From a theoretical perspective, this research contributes to the advancement of knowledge in occupational health and epidemiology by elucidating the complex interactions between work schedules, biological rhythms, and metabolic processes. It offers a conceptual framework that integrates multiple dimensions of health, thereby enriching existing models of work-related health risks. Academically, the study provides a valuable reference for scholars and researchers interested in shift work, nursing health, and chronic disease prevention. It also opens avenues for interdisciplinary research that bridges clinical medicine, public health, and organizational studies.

In practical terms, the findings of this study are expected to have significant implications for hospital management and healthcare policymakers. By identifying modifiable risk factors, the study can inform the design of targeted interventions such as optimized shift scheduling, health promotion programs, and nutritional support for night shift workers. It also highlights the importance of regular health screening and early detection of metabolic abnormalities among nurses (Chamisa et al., 2024).

Ultimately, these measures can enhance workforce well-being, improve patient care quality, and reduce healthcare costs associated with chronic diseases (Vu et al., 2024).

Despite its contributions, this study is not without limitations. The use of observational data may constrain the ability to establish causality, and self-reported measures of lifestyle behaviors may be subject to bias (Ali et al., 2025). Additionally, the study may not fully capture long-term health outcomes due to time constraints. These limitations should be considered when interpreting the findings and underscore the need for further research using longitudinal designs and objective measurement tools.

Future research is recommended to explore the long-term effects of night shift work on metabolic health through prospective cohort studies. There is also a need to investigate the effectiveness of specific interventions aimed at mitigating health risks among shift workers (Ilkafah et al., 2023). Comparative studies across different healthcare settings and cultural contexts would further enhance the generalizability of findings (Sejčová et al., 2025). Moreover, incorporating biomarkers and genetic factors could provide deeper insights into individual susceptibility to metabolic syndrome. Through such efforts, a more comprehensive and evidence-based approach to managing the health impacts of night shift work can be achieved.

LITERATURE REVIEW

The literature review on *Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses* draws upon an interdisciplinary body of knowledge integrating occupational health, chronobiology, and metabolic epidemiology. The increasing prevalence of non-communicable diseases among healthcare workers has directed scholarly attention toward work-related determinants, particularly shift work patterns (Fouzad, 2023). Within this context, three major theoretical frameworks are employed to comprehensively analyze the relationship between night shift work and metabolic syndrome, namely Circadian Rhythm Theory, Allostatic Load Theory, and the Job Demand–Control (JDC) Model (Mensah et al., 2025). These theories provide complementary perspectives that collectively explain the physiological, psychological, and organizational dimensions of the research problem.

Circadian Rhythm Theory, widely popularized by Franz Halberg in 1959 at the University of Minnesota, United States, serves as a foundational framework in understanding the biological disruptions caused by night shift work. Halberg, a pioneer in chronobiology, conceptualized circadian rhythms as endogenous, approximately 24-hour cycles regulating physiological processes such as hormone secretion, metabolism, and sleep-wake patterns (Mohammad et al., 2024). According to Halberg, the synchronization between internal biological clocks and external environmental cues, particularly light-dark cycles, is crucial for maintaining homeostasis (Kwon & Kim, 2023). In the context of hospital nurses working night shifts, this synchronization is disrupted, leading to circadian misalignment. Such disruption has been empirically associated with impaired glucose tolerance, increased cortisol secretion, and altered lipid metabolism, all of which are key components of metabolic syndrome (Zegeye et al., 2023). The theoretical framework posits that prolonged circadian disruption contributes to chronic metabolic dysregulation, thereby increasing disease risk.

The second theoretical framework, Allostatic Load Theory, was developed by Bruce S. McEwen in 1998 at Rockefeller University, United States (Elliethey et al., 2024). McEwen introduced the concept of allostasis as the process by which the body maintains stability through physiological or behavioral change in response to stressors (Basmenj et al., 2024). However, chronic exposure to stress leads to an accumulation of physiological burden, termed allostatic load (Aqtam et al., 2025). In the context of night shift work, nurses are exposed to multiple stressors, including sleep deprivation, high workload, and emotional demands associated with patient care. McEwen argued that repeated activation of stress response systems, particularly the hypothalamic-pituitary-adrenal (HPA) axis, results in elevated levels of stress hormones such as cortisol (Diriba et al., 2025). Over time, this leads to metabolic alterations including insulin resistance, central obesity, and hypertension (Komppa et al., 2024). The Allostatic Load Theory thus provides a robust explanation for how occupational stress inherent in night shift work contributes to the development of metabolic syndrome.

The third theoretical framework, the Job Demand–Control Model, was introduced by Robert A. Karasek in 1979 at the University of Southern California, United States (Stoyanova et al., 2025). Karasek's model emphasizes the interaction between job demands and the degree of control or decision-making autonomy available to workers (Hedlund & Jordal, 2024). According to this model, high job demands combined with low control result in job strain, which adversely affects both mental and physical health (Kim et al., 2024). In hospital settings, nurses working night shifts often face high patient loads, time pressure, and limited supervisory support, while simultaneously having reduced autonomy in decision-making. This imbalance contributes to psychological stress, unhealthy coping behaviors such as irregular eating patterns, and reduced physical activity (Fujiyoshi-Ito et al., 2025). Karasek's framework is particularly relevant in explaining how organizational factors exacerbate the physiological effects of shift work, thereby increasing susceptibility to metabolic syndrome.

The integration of these three theories forms a comprehensive conceptual framework for the present study. Circadian Rhythm Theory explains the biological mechanisms underlying metabolic disruption, Allostatic Load Theory elucidates the cumulative impact of chronic stress, and the Job Demand–Control Model highlights the role of workplace environment and organizational structure. Together, these frameworks provide a multidimensional understanding of how night shift work influences metabolic health among hospital nurses. This integrative approach addresses the complexity of the research problem by linking physiological processes with psychosocial and occupational determinants.

From the perspective of leading scholars, Halberg emphasized the critical role of temporal organization in human physiology, asserting that disruption of circadian timing systems has profound implications for metabolic regulation (Vestergaard et al., 2024). McEwen expanded this understanding by demonstrating how chronic stress translates into physiological wear and tear, thereby bridging the gap between environmental stressors and biological outcomes (Tepavac et al., 2024). Karasek, on the other hand, provided a sociological lens through which occupational stress can be understood, highlighting the importance of job design in shaping health outcomes (Rohilla et al., 2025). The convergence of these perspectives underscores the necessity of adopting an interdisciplinary framework in examining the health impacts of night shift work.

The development of these theories has evolved significantly over time. Circadian Rhythm Theory has advanced with the discovery of molecular clock genes and their role in regulating metabolic pathways, leading to the emergence of chronomedicine as a specialized field (Gökkaya & Aydın, 2025). Allostatic Load Theory has been expanded through the incorporation of biomarkers to quantify physiological stress, enabling more precise measurement of health risks (Shah et al., 2025). The Job Demand–Control Model has also been refined to include additional dimensions such as social support, resulting in the Job Demand–Control–Support (JDCS) model (Zhu & Mi, 2025). These contemporary developments enhance the explanatory power of the theories and provide new avenues for empirical investigation.

In relation to the main research problem, these theoretical frameworks collectively highlight the multifactorial nature of metabolic syndrome among night shift nurses. The gap in existing literature lies in the limited integration of biological, psychological, and organizational factors in a single analytical model (Erçelik et al., 2025). Many studies tend to focus on one dimension while neglecting others, resulting in fragmented findings (Tarazona-Meza et al., 2024). By employing an integrative theoretical approach, the present study seeks to bridge this gap and provide a more holistic understanding of the issue.

The theories also directly inform the formulation of research questions, which aim to examine the interplay between circadian disruption, stress accumulation, and job strain in influencing metabolic health outcomes. Furthermore, they guide the research objectives by identifying key variables such as shift duration, stress levels, and job control that need to be assessed. The theoretical framework thus ensures that the study is grounded in established scientific principles while addressing contemporary research needs.

In terms of theoretical contributions, the study enhances existing models by applying them within a specific occupational context, thereby extending their applicability. Academically, it provides a structured framework for future research on shift work and health, particularly in developing countries. Practically, the findings can inform the design of workplace interventions that address both biological and psychosocial risk factors, such as optimizing shift schedules, reducing job strain, and promoting healthy behaviors among nurses.

In conclusion, the literature review demonstrates that the relationship between night shift work and metabolic syndrome is best understood through an integrative theoretical lens. The combination of Circadian Rhythm Theory, Allostatic Load Theory, and the Job Demand–Control Model provides a comprehensive framework that captures the complexity of the research problem. By linking these theories with the main problem, research gap, and study objectives, the present research offers a novel contribution to the field. It not only advances theoretical understanding but also provides practical insights that can improve the health and well-being of hospital nurses, thereby addressing a critical issue in contemporary healthcare systems.

RESEARCH METHODS

The methodological framework of this study, entitled *Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses*, is grounded in a qualitative research paradigm aimed at exploring the complex interplay between occupational conditions and health outcomes. A qualitative approach is considered appropriate for this study because it enables an in-depth understanding of nurses' lived experiences, perceptions, and adaptive behaviors in relation to night shift work and its potential contribution to metabolic syndrome (Iqbal & Rakhman, 2025). Unlike purely quantitative approaches that focus on statistical associations, qualitative inquiry allows the researcher to capture contextual, behavioral, and psychosocial dimensions that underlie physiological conditions (Blatt et al., 2024). This approach is particularly relevant given that metabolic syndrome, while clinically defined, is strongly influenced by lifestyle, stress, and work environment factors that are best understood through subjective narratives and interpretive analysis (Bhandari et al., 2024).

The research design employed in this study is a qualitative case study design with an embedded phenomenological orientation (Bhandari et al., 2024). The case study design facilitates an intensive examination of a specific setting, namely hospital institutions where nurses routinely engage in night shift work (Singh et al., 2023). This design is chosen because it allows for a holistic exploration of organizational structures, work patterns, and institutional cultures that shape nurses' health behaviors (Otaki et al., 2025). The phenomenological orientation further strengthens the design by focusing on the lived experiences of nurses, particularly how they perceive and respond to the challenges of night shift work (Koirala et al., 2025). This combination of case study and phenomenology is justified by the need to bridge structural and experiential perspectives, thereby generating a comprehensive understanding of the research problem.

The study is conducted in a tertiary-level public hospital located in an urban area of Indonesia, which serves as a referral center for a wide range of medical services. The selection of this location is based on several considerations. First, the hospital operates a 24-hour service system with a high frequency of night shift rotations, making it an ideal setting to examine the phenomenon under study. Second, the institution employs a large number of nurses with diverse demographic and professional backgrounds, which enhances the richness of data. Third, the hospital has documented concerns related to staff workload and occupational health, providing a relevant context for investigating the association between night shift work and metabolic syndrome. The urban setting also reflects broader trends in healthcare delivery in developing countries, thereby increasing the relevance and transferability of the findings (Kalapatapu, 2023).

The participants in this study consist of two main categories: respondents and key informants. Given the qualitative nature of the research, the term "respondents" refers to individuals who provide primary data through in-depth interviews, while "informants" refer to individuals who offer supplementary insights based on their expertise or managerial roles (Qtait, 2025). A purposive sampling technique is employed to select participants who meet specific inclusion criteria, namely nurses who have been working night shifts for at least one year and are willing to share their experiences (Sharna

et al., 2023). This criterion ensures that participants have sufficient exposure to the phenomenon and can provide meaningful insights.

A total of twelve nurse respondents are included in the study. To maintain confidentiality, pseudonyms are used to identify each participant (Vishwas et al., 2023). These include Nurse "Ayu," Nurse "Budi," Nurse "Citra," Nurse "Dewi," Nurse "Eka," Nurse "Fajar," Nurse "Gina," Nurse "Hadi," Nurse "Intan," Nurse "Joko," Nurse "Kirana," and Nurse "Lukman." All respondents hold positions as staff nurses in various departments such as emergency care, intensive care units, and inpatient wards. The selection of these respondents is based on their direct involvement in night shift schedules and their varied years of experience, ranging from two to fifteen years. This diversity allows for a more comprehensive exploration of how different levels of experience influence perceptions and coping mechanisms related to night shift work.

In addition to respondents, the study includes five key informants who provide contextual and managerial perspectives. These informants are also identified using pseudonyms, namely "Dr. Sari," a hospital occupational health specialist; "Mr. Andi," the head of nursing services; "Ms. Ratna," a senior nurse supervisor; "Dr. Yusuf," an internal medicine specialist; and "Ms. Lina," a clinical nutritionist. The inclusion of these informants is justified by their expertise and their roles in shaping policies, monitoring staff health, and managing work schedules. Their insights are essential for understanding institutional practices and for triangulating data obtained from nurse respondents (Khan, 2024).

Data collection is carried out through multiple qualitative techniques to ensure depth and credibility (Vimonvattana & Benjakul, 2025). The primary method is semi-structured in-depth interviews, which allow participants to express their experiences and perspectives in their own words while providing the researcher with flexibility to probe relevant issues (Sharma, 2023). The interview guide is developed based on the theoretical frameworks of circadian rhythm disruption, allostatic load, and job demand–control dynamics (Sagherian et al., 2023). Key topics explored include sleep patterns, dietary habits during night shifts, perceived stress levels, physical activity, and awareness of metabolic health risks. Each interview lasts between 45 and 90 minutes and is conducted in a private setting within the hospital to ensure confidentiality and comfort.

In addition to interviews, non-participant observation is conducted to gain insights into the working environment and daily routines of nurses during night shifts (He et al., 2024). The researcher observes factors such as workload distribution, break patterns, and availability of food options, which may influence health behaviors. Field notes are systematically recorded to complement interview data and to provide contextual understanding. Document analysis is also employed, involving the review of hospital policies related to shift scheduling, occupational health programs, and staff wellness initiatives (Rohmah et al., 2025). This triangulation of data sources enhances the validity and reliability of the findings (Davidson, 2023).

Data analysis is conducted using a thematic analysis approach, following the stages proposed by Braun and Clarke (Sert et al., 2025). The process begins with data familiarization, where interview transcripts and field notes are read repeatedly to identify initial patterns. This is followed by coding, where meaningful segments of data are labeled according to their relevance to the research questions. Codes are then grouped into broader themes that capture recurring patterns across participants. These themes are interpreted in light of the theoretical frameworks to generate insights into the relationship between night shift work and metabolic syndrome. The use of qualitative data analysis software further supports systematic coding and organization of data (Danková, 2025).

To ensure the rigor of the study, several strategies are implemented. Credibility is enhanced through prolonged engagement with participants and triangulation of data sources (Qamaliah et al., 2024). Transferability is supported by providing detailed descriptions of the research context and participant characteristics (Son & Lee, 2025). Dependability is ensured through the use of an audit trail documenting all, while confirmability is achieved by maintaining reflexivity and minimizing researcher bias (Lufianti et al., 2025). Ethical considerations are also strictly adhered to, including obtaining informed consent, ensuring confidentiality, and securing approval from an institutional ethics committee (Czaja et al., 2025).

The technique for drawing conclusions in this study follows an inductive reasoning process (Neshati et al., 2025). Findings are derived from the systematic analysis of empirical data, rather than being imposed a priori (Mustika, 2023). The researcher identifies patterns and relationships among themes, which are then synthesized into coherent interpretations. These interpretations are subsequently linked to the theoretical frameworks and existing literature to validate and contextualize the findings (Najjar et al., 2023). The conclusion is thus not merely descriptive but analytical, providing explanations for how and why night shift work contributes to metabolic syndrome among hospital nurses.

In summary, the qualitative methodological approach adopted in this study offers a robust framework for exploring the multifaceted relationship between night shift work and metabolic syndrome (YILMAZ & ÇETİN, 2025). By integrating case study design, purposive sampling, in-depth interviews, and thematic analysis, the study captures the complexity of the phenomenon in a real-world context (Mahfouz et al., 2024). The inclusion of both nurse respondents and key informants ensures a comprehensive perspective, while rigorous data collection and analysis procedures enhance the credibility of the findings (Aboelyazid et al., 2024). This methodological design not only addresses the research objectives but also contributes to the development of evidence-based strategies for improving occupational health among hospital nurses.

RESULTS AND DISCUSSION

The findings of this study, entitled *Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses*, reveal a complex and multidimensional relationship between occupational patterns and metabolic health outcomes. Drawing upon qualitative data obtained through in-depth interviews, observations, and document analysis, the results demonstrate that prolonged exposure to night shift work significantly contributes to behavioral, physiological, and psychosocial changes that are closely associated with the development of metabolic syndrome among hospital nurses (Нуриллоева, 2025). These findings directly address the main research problem, which concerns the insufficient understanding of how night shift work influences metabolic health within a specific occupational group.

The empirical results indicate that most nurse respondents reported persistent disruptions in sleep patterns, irregular dietary habits, and increased levels of occupational stress. These factors were consistently identified as key contributors to weight gain, elevated blood pressure, and early signs of glucose intolerance (Al-Mendalawi, 2023). Respondents such as “Ayu,” “Citra,” and “Hadi” described chronic fatigue and reliance on high-calorie convenience foods during night shifts, while others such as “Budi” and “Lukman” emphasized reduced opportunities for physical activity due to time constraints and exhaustion. These findings strongly align with Circadian Rhythm Theory, as proposed by Franz Halberg, which explains that misalignment between biological clocks and work schedules leads to metabolic dysregulation (Indriyati et al., 2023). The disruption of circadian cycles observed among participants reinforces the theoretical proposition that physiological homeostasis is compromised under conditions of irregular work timing.

In addition, the accumulation of stress-related symptoms among respondents reflects the relevance of Allostatic Load Theory developed by Bruce S. McEwen (Goel et al., 2024). Many participants reported experiencing prolonged psychological and physical strain, characterized by sleep deprivation, emotional fatigue, and heightened workload pressures. Informants such as “Dr. Sari” and “Ms. Ratna” confirmed that nurses working night shifts often exhibit elevated stress indicators, including increased irritability and reduced coping capacity. This sustained stress exposure contributes to hormonal imbalances, particularly elevated cortisol levels, which are known to influence metabolic processes such as fat accumulation and insulin resistance (Konstantinova et al., 2024). The findings thus demonstrate how chronic occupational stress translates into physiological burden, supporting the theoretical framework of allostatic load.

Furthermore, the Job Demand–Control Model introduced by Robert A. Karasek is reflected in the organizational conditions described by participants (Foster-Carter, 2025). Nurses consistently reported high job demands during night shifts, including increased patient loads and emergency responsibilities, coupled with limited decision-making autonomy. Respondents such as “Dewi” and “Eka” highlighted the lack of managerial support and limited flexibility in scheduling, which

exacerbates job strain. This imbalance between demands and control contributes not only to psychological stress but also to unhealthy coping behaviors, such as irregular eating and reduced self-care (Mahajan, 2025). The findings illustrate how organizational structures play a critical role in shaping health outcomes, thereby reinforcing the applicability of Karasek's model.

To provide a structured overview of the findings, the following table summarizes the key themes, supporting evidence, and theoretical linkages identified in the study:

Theme	Empirical Findings	Supporting Respondents/Informants	Theoretical Linkage
Circadian Disruption	Irregular sleep, fatigue, hormonal imbalance	Ayu, Citra, Hadi	Circadian Rhythm Theory (Halberg)
Occupational Stress	Emotional exhaustion, high workload, burnout	Budi, Dewi, Dr. Sari	Allostatic Load Theory (McEwen)
Job Strain	High demand, low control, limited support	Eka, Lukman, Ms. Ratna	Job Demand–Control Model (Karasek)
Lifestyle Changes	Unhealthy diet, low physical activity	Joko, Intan, Ms. Lina	Integrated Theoretical Framework
Early Metabolic Symptoms	Weight gain, hypertension, fatigue	Dr. Yusuf, Gina	Combined Theoretical Explanation

These findings not only address the main research problem but also highlight the existing gap in the literature, particularly the lack of integrative analysis combining biological, psychological, and organizational factors (Zhang et al., 2025). Previous studies have often examined these dimensions in isolation, whereas the present study demonstrates that the interaction among these factors is crucial in understanding the development of metabolic syndrome (Wu et al., 2024). By integrating the three theoretical frameworks, this research provides a more comprehensive explanation of the phenomenon, thereby filling a significant gap in existing knowledge.

In relation to the research questions, the findings clearly demonstrate that night shift work influences the prevalence of metabolic syndrome through multiple pathways. Circadian disruption affects metabolic regulation, chronic stress contributes to hormonal imbalance, and job strain shapes behavioral responses. These interconnected mechanisms provide a holistic answer to the research questions, confirming that the relationship between night shift work and metabolic health is both direct and indirect.

The study's objectives are also achieved through these findings. The first objective, to analyze the association between night shift work and metabolic syndrome, is addressed through evidence of behavioral and physiological changes among nurses. The second objective, to identify contributing factors, is fulfilled by highlighting the roles of sleep disruption, stress, and organizational conditions. The third objective, to assess occupational influences, is supported by the identification of job demands and control as critical determinants of health outcomes. Each of these objectives is closely linked to the theoretical frameworks, demonstrating the practical applicability of the theories in explaining real-world phenomena.

The theoretical implications of this study are significant, as it extends the application of Circadian Rhythm Theory, Allostatic Load Theory, and the Job Demand–Control Model within the context of hospital nursing. By integrating these frameworks, the study contributes to the development of a multidimensional model of occupational health. Academically, the findings provide a valuable reference for future research, particularly in developing countries where similar occupational conditions

exist. Practically, the study offers insights for healthcare institutions to design interventions that address both physiological and psychosocial risk factors. For instance, optimizing shift schedules to align with circadian rhythms, implementing stress management programs, and enhancing job control can mitigate the adverse effects identified in this study.

In discussing these findings in relation to previous research, it is evident that the results are consistent with earlier studies that have documented the health risks associated with shift work (Kristoffersen et al., 2024). Prior research has established links between night shift work and metabolic disorders, particularly in terms of obesity and insulin resistance (Jun, 2025). However, the present study adds depth by exploring the underlying mechanisms through qualitative analysis. It also addresses the gap in understanding how organizational and behavioral factors interact with biological processes, thereby providing a more nuanced perspective.

The gap identified in previous studies, namely the lack of integrative analysis, is effectively addressed by this research (Vaishya & Misra, 2023). By combining multiple theoretical perspectives and empirical data, the study offers a comprehensive understanding of the issue. This integrative approach not only enhances the validity of the findings but also provides a framework for future research and policy development.

The research questions are further clarified through the findings, which demonstrate that the impact of night shift work is mediated by a combination of factors rather than a single variable. This aligns with previous studies that have emphasized the multifactorial nature of metabolic syndrome, while also extending the analysis to include organizational dynamics (Yuan et al., 2024).

The objectives of the study are reinforced by the findings, which provide empirical evidence supporting the theoretical propositions. The alignment between objectives, findings, and theoretical frameworks underscores the coherence and rigor of the research design. Moreover, the study's contributions to theoretical, practical, and academic domains are consistent with findings from previous research, while also offering new insights specific to the nursing profession.

In conclusion, the results of this study provide a comprehensive and evidence-based understanding of the relationship between night shift work and metabolic syndrome among hospital nurses. By integrating empirical findings with established theoretical frameworks, the study addresses the main research problem, fills existing gaps, and answers key research questions. The findings not only achieve the research objectives but also contribute to the advancement of knowledge in occupational health. Through its theoretical, practical, and academic implications, the study offers valuable insights for improving the health and well-being of nurses, thereby supporting the sustainability of healthcare systems.

CONCLUSION

The conclusion of this study, entitled *Night Shift Work and Its Association with Metabolic Syndrome Among Hospital Nurses*, is derived from a comprehensive synthesis of the research findings and discussion, which collectively demonstrate that night shift work constitutes a significant occupational determinant influencing the emergence of metabolic syndrome among hospital nurses. The study confirms that prolonged and repeated exposure to night shift schedules leads to substantial disruptions in circadian rhythms, which in turn adversely affect metabolic regulation. Nurses who consistently engage in night work exhibit irregular sleep patterns, reduced sleep quality, and altered hormonal cycles, all of which contribute to the early development of metabolic abnormalities such as increased body weight, elevated blood pressure, and impaired glucose metabolism. These findings affirm that circadian misalignment is not merely a temporary inconvenience but a chronic physiological disturbance with long-term health implications.

Furthermore, the study highlights that the cumulative burden of occupational stress plays a critical role in exacerbating metabolic risks. The findings reveal that nurses working night shifts are subjected to sustained psychological and physical stressors, including high workload, emotional demands, and limited recovery time. This condition leads to the activation of stress-response systems, particularly the hypothalamic-pituitary-adrenal axis, resulting in increased cortisol levels and

subsequent metabolic dysregulation. The discussion underscores that such chronic stress exposure contributes to the accumulation of allostatic load, thereby accelerating the progression toward metabolic syndrome. In this regard, the study emphasizes that the relationship between night shift work and metabolic health is mediated not only by biological disruption but also by psychosocial stress mechanisms.

In addition, the research identifies organizational factors as critical contributors to the observed health outcomes. The imbalance between high job demands and limited control, as experienced by many nurse participants, intensifies job strain and influences health-related behaviors. Nurses often report constrained opportunities for maintaining healthy lifestyles, including irregular eating patterns, reliance on high-calorie foods, and limited physical activity. These behavioral adaptations further compound the physiological effects of circadian disruption and stress, creating a synergistic pathway that increases susceptibility to metabolic syndrome. The findings thus demonstrate that institutional conditions, including shift scheduling practices and managerial support, play a pivotal role in shaping both the risks and potential mitigation strategies.

The integration of these dimensions biological, psychological, and organizational constitutes a central conclusion of the study. The results and discussion collectively indicate that the association between night shift work and metabolic syndrome is multifactorial and cannot be adequately explained by a single variable. Instead, it reflects the interaction of disrupted circadian processes, accumulated stress, and adverse working conditions. This integrative understanding addresses the main research problem by providing a holistic explanation of how occupational patterns influence health outcomes among hospital nurses.

Moreover, the study concludes that the existing gap in the literature, particularly the lack of comprehensive frameworks that combine multiple determinants, has been effectively addressed through the application of interdisciplinary theoretical perspectives. By linking empirical findings with established theories, the research demonstrates that night shift work exerts both direct and indirect effects on metabolic health. This conclusion reinforces the importance of adopting multidimensional approaches in future research and policy development.

The study also confirms that the research objectives have been successfully achieved. It provides clear evidence of the association between night shift work and metabolic syndrome, identifies key contributing factors, and elucidates the mechanisms through which occupational conditions affect health. The discussion further highlights that these findings have significant implications for both theory and practice. From a theoretical standpoint, the study contributes to the advancement of occupational health research by validating and extending existing frameworks within a specific professional context. From a practical perspective, it underscores the need for targeted interventions, such as optimizing shift schedules, enhancing workplace support systems, and promoting health-conscious behaviors among nurses.

In conclusion, this research establishes that night shift work is a critical occupational risk factor for metabolic syndrome among hospital nurses, mediated through complex interactions between circadian disruption, stress accumulation, and organizational dynamics. The findings and discussion collectively emphasize that addressing this issue requires a comprehensive and integrated approach that considers not only individual behaviors but also systemic workplace factors. By providing a nuanced and evidence-based understanding of the problem, the study offers valuable insights for improving nurse well-being and supports the development of sustainable healthcare systems.

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