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Association Between Food Timing Irregularity, Gastrointestinal Symptoms, and Nutritional Well-Being Among Shift-Working Adults

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Abstract

Shift work is considered to be among the leading causes of changes in food habits and meals, as well as a cause of disturbances of functioning of gastrointestinal tract. The purpose of this research is to investigate the connection between food timing problems, gastrointestinal symptoms, and nutrition in shift workers. The influence of an unsteady food timing schedule, delayed meals, skipped meals, and nighttime food intake on the condition of gastrointestinal health and nutrition will be studied. Gastrointestinal problems that are usually experienced by people, such as bloating, heartburn, stomach pain, constipation, and indigestion, and food-related habits and choices wilal be investigated within the research area. Data collected from the study can be analyzed using descriptive statistics and correlation analysis, along with appropriate statistical tests, to establish any relationships between irregular food timing and reported outcomes on health status. The study will help establish whether there exists any relationship between increased meal-timing irregularity and increased discomfort in the gastrointestinal tract, as well as poor nutrition among individuals. It will also emphasize the significance of having regular eating times, a proper and balanced diet, and proper hydration regardless of the time pressures of work. The study will help understand the difficulties faced by shift workers with respect to their diet.

Keywords: Shift-Working Adults, Food Timing Irregularity, Gastrointestinal Symptoms, Nutritional Well-Being, Meal Timing Patterns, Digestive Health, Dietary Habits.

1 INTRODUCTION

1.1 Background of Shift Work and Circadian Disruption

Shift work is employed in health care, manufacturing, transport, and other critical industries for providing round-the-clock services. Nevertheless, shift work interferes with circadian rhythms, which control sleeping, metabolism, digestion, and other bodily functions. Food intake timing is a vital part of the circadian rhythm, as meals impact biological rhythms separately from the sleeping-waking cycle. Hence, circadian misalignment of eating habits occurs in shift workers, which might result in gastrointestinal problems and impaired nutrition (Wehrens et al., 2017; Flanagan et al., 2021). Circadian misalignment can also impact the interplay between sleep, hormonal functioning, and digestion processes. Changes in daily routines make it difficult to follow regular meal times, especially

for those who perform night shifts on a constant basis. Knowledge about biological rhythms is crucial in exploring the connection between the occupation and nutritional health.

1.2 Food Timing Irregularity in Shift-Working Adults

For individuals who work shifts, it is common to have irregular food timing due to the rotational shifts, night work, limited time to eat, and variation in appetite. For instance, irregular meals may result in delayed meals, missed meals, night eating, and irregular eating intervals, among others. In a systematic review, shift work is linked to changes in the eating pattern and eating behavior of individuals, but this may depend on the work schedule and personal situations (Clark et al., 2023; Souza et al., 2019). Food timing may be related to gut comfort, satiety, alertness, and nutrition, which means it is one of the health factors in the lives of shift workers (de Rijk et al., 2024). This irregularity may be experienced differently depending on the duties of the individual, shift time, and other factors like personal eating habits. While some individuals may take their meals before and after work, there are also individuals who eat at night through snacking and easy-to-access foods. It is crucial to understand the meal frequency, interval between meals, and night eating.

1.3 Research Problem, Objectives, and Significance of the Study

Working shifts can result in working conditions that may affect normal eating habits and nutritional status of individuals. Though food intake quality and nutritional status were previously studied among shift workers, the connection between eating-time irregularity, gastrointestinal symptoms, and nutritional status has not yet been fully investigated. The purpose of the current study is to investigate the association between food intake timing irregularity, gastrointestinal symptoms, and nutritional status among shift-working adults. Additionally, differences in eating-time patterns will be identified, and whether eating-time irregularity is associated with increased gastrointestinal problems and poor nutritional status will be assessed. The results obtained in the course of the study may contribute to the understanding of the issues connected with nutrition among occupational groups and help develop specific recommendations concerning meal timing for shift workers. It is crucial to know the individual and work environment-related reasons that cause inconsistency in eating schedules. By investigating dietary behavior and its connection with gastrointestinal symptoms and nutritional status, the researcher gets a chance to take into account all aspects of the problem.

2 REVIEW OF LITERATURE

2.1 Shift Work, Biological Rhythms, and Eating-Time Patterns

The human circadian system is responsible for the regulation of daily physiological functions, such as sleeping, hormone release, metabolism, and digestion (Wehrens et al., 2017). Food consumption becomes a synchronizing cue for peripheral biological clocks and can affect the synchronization of the human circadian system (Wehrens et al., 2017). Chrononutrition studies focus on the significance of meal timing as well as on types of foods consumed because of their relationship to biological rhythms

and metabolic processes (Flanagan et al., 2021). Eating during the biological night for people who work in shifts might lead to the misalignment of food consumption and physiological preparedness for digestion and metabolism of consumed products (Adafer et al., 2020).

The correlation between the rhythm of biological clocks and food consumption creates the basis for the chrononutrition study (Reytor-González et al., 2025). The alteration of sleep time and meals can affect the synchronization of the biological clock of a person with his or her daily consumption of nutrients. Consequently, it can be helpful to evaluate the diet patterns in relation to the work schedule of a person.

2.2 Irregular Meal Timing and Gastrointestinal Function

Gastrointestinal symptoms have been mentioned with respect to shift work because unusual work hours can influence meal timings and digestion. Reviewing gastrointestinal conditions for shift workers found that shift work is an occupational factor related to digestive health (Knutsson & Bøggild, 2010). Recent studies have considered gastrointestinal symptoms along with nutritional intake for shift workers, indicating the necessity of conducting more research into the link between food intake and gastrointestinal complaints (Alyami et al., 2025). There are also experimental studies with female healthcare workers that consider the effect of meal frequency and glycemic index on night shifts and their connection to gastrointestinal complaints, hunger, and alertness (de Rijk et al., 2024). This indicates the importance of studying food irregularity with respect to gastrointestinal complaints. The particularities of eating patterns could be related to the digestive discomfort of shift workers. For instance, the consumption of meals at irregular intervals, large meals at nighttime, and missed meals could be considered relevant eating habits for gastrointestinal evaluation.

2.3 Nutritional Well-Being and Dietary Challenges in Shift Workers

Nutritional well-being in case of shift work may be affected by changes in the frequency of meals, food selection, energy intake, as well as the access to balanced meals during work time. For instance, a systematic review and meta-analysis concerning the impact of rotational shift work identified dietary changes as a result of this form of work schedule, thus implying that shift work influences eating habits (Clark et al., 2023). There are studies concerning the nutritional well-being in case of rotating night shifts among nurses, which implies that shift eating habits are related to nutritional assessment (Ulusoy et al., 2022). Moreover, there was a pilot study of the nutritional well-being and dietary challenges of shift-working nurses (Varli & Bilici, 2016). Additionally, there were studies on day vs night shifts comparing energy and nutrient intake, showing the variation of eating habits due to different schedules of work (Fradkin et al., 2019). Access to good food during work time is another aspect that should be considered when talking about nutrition in the case of shift work. Workers who have limited opportunities to have regular meal breaks may eat only prepackaged food, processed food, ready-to-eat meals, etc. Thus, food quality, hydration, and meal adequacy can be assessed.

2.4 Behavioral and Occupational Factors Influencing Meal Timing

The timing of meals among shift workers is dependent on various behavioral and work-based aspects, such as shift length, workload, availability of breaks, availability of food, sleep pattern, and changes in appetite. Review of eating behavior of shift workers has shown the importance of analysis of what, when, where, and why individuals are eating, and how the food choice is determined by individual and occupation-related factors (Gupta et al., 2019). Such factors can lead to disorganization of meal schedules and be a barrier to maintaining consistent eating behavior. It is important to consider such factors while considering the relation between meal timing, gastrointestinal disorders, and nutrition. Personal needs and the workplace can influence the eating behavior of individuals. Commuting, family responsibilities, facilities at work, and food services can also affect eating behavior.

2.5 Research Gap

Earlier research has studied the influence of shift work on eating behavior, diet, digestive disorders, and nutrition. Nonetheless, studies in each of these fields are conducted independently of one another, and few have paid attention to the relationship of these concepts in combination with shift workers. In particular, the connection between food timing irregularity, gastrointestinal symptoms, and nutritional status requires further investigation. This study attempts to address this gap by taking food timing irregularity as a focal point and investigating its association with gastrointestinal symptoms and nutritional status in the case of shift workers.

3 METHODOLOGY

3.1 Research Design and Conceptual Study Framework

The research will employ the cross-sectional study design, which seeks to find statistical association between food timing irregularity, gastrointestinal symptoms, and nutritional well-being as opposed to establishing causation or chronological sequence. In light of the cross-sectional design employed, the study will be unable to establish whether the irregular eating habits cause the gastrointestinal symptoms or whether the pre-existing condition causes the changes in eating habits. The conceptual model will treat food timing irregularity as the independent variable, the gastrointestinal symptoms as the dependent variable, and the nutritional well-being as an associated health outcome. The characteristics of shift work, such as the work schedule, number of night shifts, and shift rotations, are contextual variables in this model.

The framework presented in figure 1 is based on the collection of data among shift-working employees through a survey regarding their eating schedule, gastrointestinal symptoms, and dietary practices, after which these relationships will be analyzed to generate a conceptual risk category and nutrition policy for the workplace.

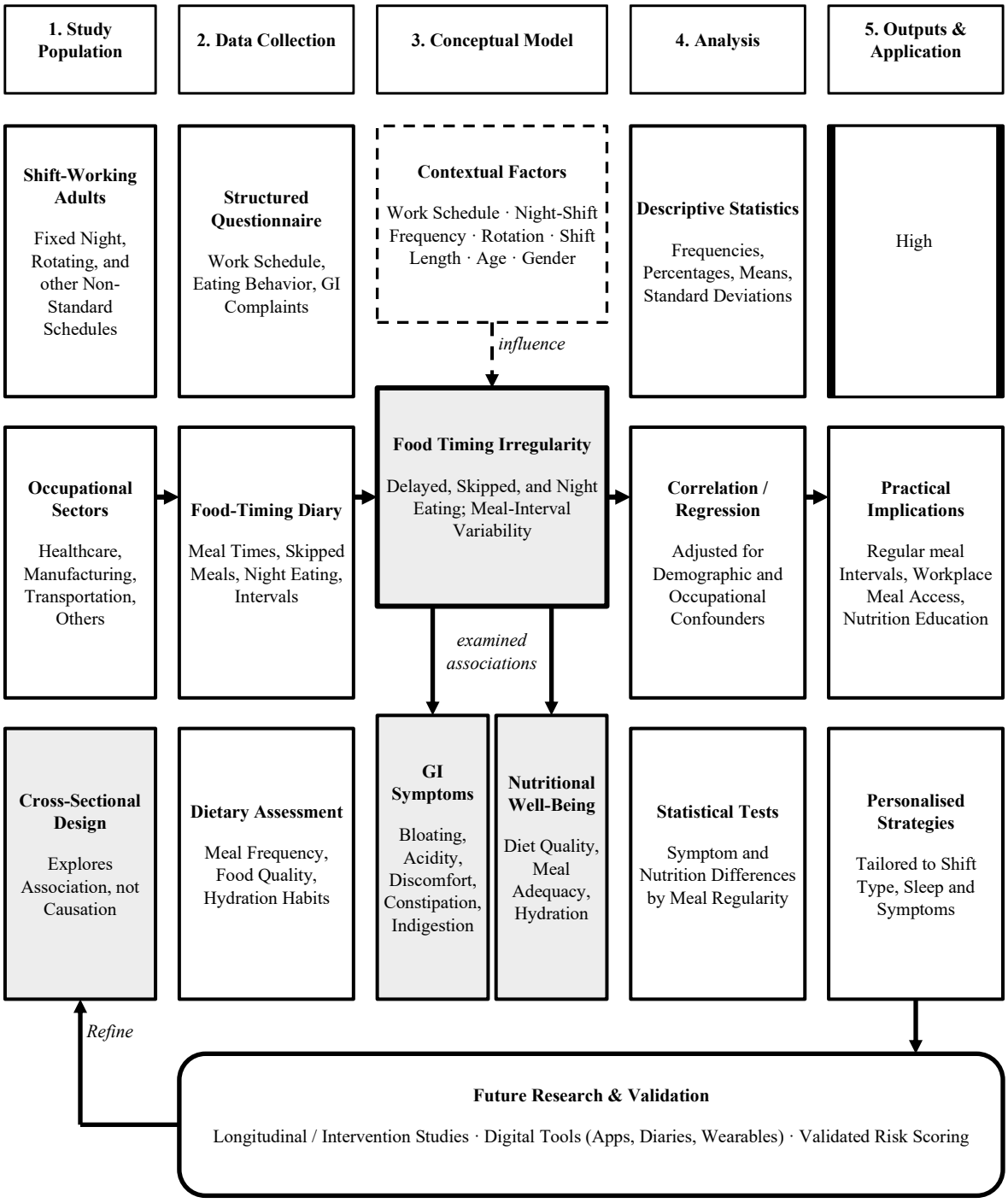


Figure 1: Circadian-Aware Architecture Framework Linking Food Timing Irregularity, Gastrointestinal Symptoms and Nutritional Well-Being in Shift-Working Adults

3.2 Participant Selection and Shift-Work Characteristics

The target population consists of adults employed under shift work, which could be those who have night shift work or other kinds of non-traditional schedules. The sample includes adults who work as shift workers and are capable of providing relevant information regarding their meal times, gastrointestinal symptoms, and eating habits. The occupational variables include age, gender, occupation, experience in shift work, type of shift work, length of shift work, and number of night shifts. These variables would help in understanding the context of differences in eating habits and health

issues. The sample could be recruited from occupations such as healthcare, manufacturing, transportation, and other industries where workers have to work outside normal daytime work schedules. Information related to their shift work and meal breaks would be helpful in differentiating eating habits in different occupations.

3.3 Assessment of Food Timing Irregularity and Meal Patterns

The timing of meals can be studied through data on schedule of food intake, meal frequency, skipping meals, nocturnal meals, and variability in meal time on work and non-work days. The participant may describe his or her usual food timing through the use of dietary assessment tools that include recording of the usual time of consumption of breakfast, lunch, dinner, and snacks. The variability of meal times can be estimated through the study of the difference in meal times between days, as well as eating frequency during overnight shifts. These parameters can be used for the estimation of the regularity of food intake and identification of common meal pattern disturbances experienced by shift workers. Also, the period of time between two consecutive meals and changes in food intake schedules during rotating shifts may be considered when assessing the meal time patterns of shift workers. A structured recording of the meal times can allow identifying whether participants have stable food intake schedules or suffer from disturbances in their meal time patterns.

4 RESULTS AND DISCUSSION

4.1 Shift-Work Profiles and Food Timing Irregularity Patterns

The analysis will aim to present the number of respondents who are on fixed day shift work, fixed night shifts, and rotating shifts. The patterns of food intake may be described by considering the frequency of meals, skipped meals, food intake during night hours, and variability in meal timing schedules. Analysis of differences between the shift-work groups will be helpful in identifying any occupational factors that affect irregular food intake. The results will be presented using the relevant measures of descriptive statistics depending upon the type of data being analyzed, which include frequencies, percentages, means, and standard deviations. The analysis may further aim at examining differences in eating schedules with respect to the length of shifts, frequency of night work, and meal break schedules. This will help understand how occupational factors affect regularity of food intake. The results will also assist in identifying groups with more disruptions in their mealtime schedules.

The following table gives the main work-related factors that could be causing irregular eating patterns in workers. Table 1 shows the effect that work conditions can have on mealtime and nutrition.

Table 1: Occupational Factors Influencing Food Timing Irregularity Among Shift-Working Adults

Occupational Factors	Workplace Conditions	Effect on meal timing	Possible dietary challenges
Night-Shift Duties	Working During Nighttime Hours	Increased Nighttime Eating	Disrupted Eating Routines
Rotating Shifts	Frequent changes in work schedules	Inconsistent Meal Timings	Irregular Food Intake
Workload Intensity	High Work Pressure and Continuous Tasks	Delayed or Skipped Meals	Reduced Meal Frequency
Limited Meal Breaks	Insufficient Time for Eating	Unplanned meal intervals	Inadequate Meal Intake
Food Availability	Limited Access to Nutritious Food	Dependence on convenient meal timings	Poor Dietary Diversity
Sleep Pattern Changes	Altered Sleep and Wake-Up Schedules	Changes in Regular Meal Schedules	Inconsistent Eating Habits

4.2 Association Between Meal Timing Variability and Gastrointestinal Symptoms

This subpart explores whether higher variation in meal timing leads to more gastrointestinal symptoms such as bloating, abdominal discomfort, dyspepsia, nausea, and changes in bowel movements. Statistical tests may be conducted to determine associations between the frequency or severity of symptoms in participants who have more stable or less stable meal patterns. Shift work-related factors may also be taken into account in such analyses. The conclusion must be based on established associations and not involve drawing causative links between irregular meal timing and gastrointestinal symptoms. This section may evaluate if night-time meals, skipped meals, and non-standard meal intervals result in specific gastrointestinal symptoms. These symptoms may be measured by the frequency or severity of occurrence, depending on the chosen measurement tool.

4.3 Relationship Between Food Timing Irregularity and Nutritional Well-Being

The connection between irregularity of food timing and nutritional health can be examined through assessment of dietary quality, adequacy of meals, food group intake, as well as perceived nutritional problems. Individuals experiencing high levels of meal skipping or irregularities in eating schedule can be compared to those who are eating meals at regular intervals. Analysis may also involve investigation of the possible impact of certain job-related factors such as frequency of working shifts and insufficient time for lunch breaks. Results of the analysis will give an opportunity to explore the possible importance of regular meal scheduling for the promotion of nutritional well-being in shift workers. Analysis may also include exploration of the possibility that irregularities in food timing are linked to lower variety of food products consumed, reliance on fast food products, or uneven energy intake.

These measures may help to develop a broader picture of nutritional well-being than only meal frequency.

Table 2: Dietary Indicators Associated with Food Timing Irregularity Among Shift-Working Adults

Dietary Indicators	Regular Meal Timing	Irregular Meal Timing	Potential Nutritional Concerns
Meal Frequency	Consistent Daily Meals	Frequent Meal Skipping	Inadequate Food Intake
Dietary Diversity	Inclusion of Different Food Groups	Dependence on Limited Food Choices	Reduced Nutrient Variety
Food Quality	Balanced and Planned Meals	Frequent Convenience-Food Consumption	Poor Dietary Quality
Energy Intake	Relatively Consistent Intake	Variable Daily Energy Intake	Inconsistent Energy Balance
Fruit and Vegetable Intake	Regular Consumption	Irregular or Reduced Consumption	Lower Dietary Diversity
Hydration Habits	Consistent Water Intake	Irregular Water Consumption	Inadequate Hydration

Table 2 above represents the comparison of the indicators of diet of individuals having scheduled and unscheduled meal times among the shift workers. The table highlights some problems related to nutrition based on meal time schedule.

4.4 Innovative Circadian Meal-Timing Risk Classification Framework

Proposed food intake classification system has been developed for classifying individuals based on the timing of meal consumption along with their health status. The classification system consists of the following three categories:

- Low-level variability: Consistent meal timing, low nighttime consumption, and low instances of gastrointestinal problems.
- Moderate-level variation: Distinct meal timing variation, skipping meals, and gastrointestinal problems from time to time.
- High-level variation: Irregular meal timing pattern, nighttime intake or skipped meals, and gastrointestinal issues as well as nutritional problems.

It is important to note that such a categorization scheme does not have any predictive power, as it serves only as an exploratory tool to classify individuals. Since the research employs a cross-sectional design, such levels cannot indicate future health problems or pose risk in any way. In addition, this categorization does not provide any prediction or diagnosis – it is used only for grouping of the observed phenomena in order to identify possible areas that might need further analysis of the diet.

4.5 Integrated Discussion of Occupational, Dietary, and Digestive Factors

The integrated discussion will focus on how the combination of shiftwork scheduling, job stressors, and food timing patterns could possibly be related to gastrointestinal symptoms and nutritional health. A lack of meal breaks, night shifts, and shift rotation could play a role in the development of irregular eating habits, while food timing could be important for digestion and adequate nutrition. This model will contribute to the integration of all these factors for providing an explanation of the problems with nutrition faced by the shift workers. All the results that have been found in this study must be explained, bearing in mind the research design and measurement techniques, as well as the data collected. The discussion may also refer to the impact of the work environment on the ability to keep a regular eating schedule. Different access to food products, workload, and sleep schedule may cause different eating habits.

5 CONCLUSION AND FUTURE RECOMMENDATIONS

5.1 Summary and Overall Conclusion

This research is focused on the evaluation of the relationship between the irregularity of food intake, gastrointestinal problems, and the nutritional status of adult people working in shifts. The importance of meal timing, characteristics of shift work, and food habits in the study of occupational nutrition issues are described. The methodological approach offered for the analysis is based on the assumption that the meal timing irregularity is one of the factors associated with gastrointestinal and nutrition problems. Overall, the research demonstrates the necessity to consider not only the quality but also the timing of the food eaten when analyzing the nutrition state of shift workers. The consideration of all the factors mentioned above will help to gain a better understanding of the issues faced by shift workers.

5.2 Practical Implications for Shift-Work Nutrition and Digestive Health

Some of the practical uses of this study would be in developing a dietary approach that looks at working hours and digestion needs. The proper feeding time, proper foods, and provision of good food during night shifts can solve some of the occupational nutrition challenges. This challenge may be aided through proper provision of meal times, good food, and nutrition education. Another approach could be meal preparation before the start of work, proper storage of food, hydration, and identification of digestion-related symptoms. It is also important to have other approaches for people with fixed and rotating night shifts.

5.3 Personalized and Workplace-Based Nutritional Strategies

Tailored meal-timing strategies could include shift type, duration of work shifts, sleep schedule, preferred meals, and symptoms related to digestion. Tailored meal timing may be beneficial for shift workers because it will involve planning for balanced meals and avoiding reliance on inconsistent eating patterns. Workplace intervention could entail providing easily accessible healthy food choices, appropriate facilities to eat, and flexible meal breaks. These interventions may assist in overcoming

occupational obstacles that prevent employees from eating regularly and adopting better nutritional habits. Personalized meal-timing strategies could take into account the number of night shifts and the availability of meal breaks during challenging work shifts. Employers can collaborate with nutritionists to come up with appropriate guidelines based on the work process.

5.4 Proposed Circadian-Aware Framework and Future Research

The suggested circadian-sensitive approach will be the fusion of all the qualities associated with shift work, regular eating time, digestive complaints, and nutrition health in one experimental model. This framework includes evaluating work schedule and meal pattern, detecting irregular eating behavior, and categorizing cross-sectional observations by low, moderate, or high variation. However, longitudinal and intervention study designs are absolutely essential for future research in order to examine the directionality of relationships, establish the temporal order, and validate the framework prior to its practical implementation. Future research may employ technological advances such as mobile apps, food timing logs, and wearable-supported assessment of dynamic eating patterns. Further investigation may include larger anda different occupational groups to find out whether the association varies in various industries and shift work schedules. Dietary assessment may be conducted repeatedly to learn more about the meal timing dynamics during work days, rest days, and rotating shifts. Future researchers may explore the effect of nutritional interventions in the workplace on meal regularity, gastrointestinal well-being, or nutritional parameters. The development of a standardized scoring system will be necessary before the risk classification can be implemented in practice.

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