SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 13245-13258
Open Access. Online & Print

DOI: 10.5281/zenodo.20386559

INTERRELATIONSHIP BETWEEN DIETARY PATTERNS, PERCEIVED STRESS, PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR, AND BODY MASS INDEX AMONG INDUSTRIAL WORKERS: A CROSS-SECTIONAL ANALYTICAL STUDY

Akshaya V[1], Rohini Durairaj[2*], Suganthi V[3]

1Research Scholar, Department of Biochemistry, School of Life Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, Tamil Nadu
*2*Assistant Professor, Department of Biochemistry, School of Life Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, Tamil Nadu*
3Associate Professor, Department of Home Science – Nutrition, Food service management and Dietetics, Anna Adarsh College for Women, Chennai, India

Received: 01/03/2026
Accepted: 26/04/2026

Corresponding Author: Rohini Durairaj (drrohinidurairaj@gmail.com)

ABSTRACT

Lifestyle-related risk factors are becoming more common in the workplace, and thus in industrial workers, and are a factor in the rising burden of non-communicable diseases (NCDs). Industrial workers have been observed to suffer from occupational stress, irregular eating patterns, lack of exercise and sitting for long periods of time, which can negatively impact their nutrition and health. The present study was an attempt to study the interrelationship between dietary patterns, perceived stress, physical activity, sedentary behaviour and body mass index (BMI) in industrial workers. The study was of cross-sectional, analytical type where 410 industrial workers working in selected industrial units in and around Tamil Nadu participated. Structured and standardised instruments were used to collect data such as a modified Food Frequency Questionnaire (FFQ), Perceived Stress Scale (PSS-10) and Global Physical Activity Questionnaire (GPAQ). Anthropometric measurements were taken to evaluate BMI and other nutrition related parameters. The associations among the study variables were assessed by descriptive statistics, reliability analysis, Spearman correlation, chi-square analysis, and multiple linear regression. The results showed that BMI was strongly related to some lifestyle factors. BMI had a strong positive association with perceived stress score and sedentary behaviour, and a strong negative association with dietary score and physical activity level ($p<0.001$). The participants with overweight and obese BMI categories had higher levels of sedentary behaviour and stress than those with normal BMI categories. The multiple regression analysis showed that dietary score, stress score, physical activity, sedentary behaviour, work schedule and work experience were significant factors in predicting BMI. This study shows that there are complex interactions among occupational lifestyle behaviours and nutritional status in industrial workers. The results highlight the need for an integrated workplace health promotion program that includes healthy eating, stress reduction, regular physical activity and decreasing sedentary behaviour to help employees maintain their health and reduce the risk of lifestyle-related diseases.

KEYWORDS: Industrial workers, Dietary pattern, Perceived stress, Physical activity, Sedentary behaviour, Occupational health, BMI.

1. INTRODUCTION

Non-communicable diseases (NCDs) remain a significant global public health problem, and are the cause of a significant burden of early death and extended disability in the world. Nearly 74% of all global deaths are caused by chronic non-communicable diseases (NCDs) (World

Health Organization, 2025), especially cardiovascular diseases, diabetes mellitus, chronic respiratory diseases and cancers. There has been a strong link between increasing prevalence of these conditions and modifiable lifestyle-related risk factors, such as unhealthy diets, physical inactivity, obesity, psychological stress and prolonged sitting time (World Health Organization, 2025). Due to rapid industrialisation and urbanisation, daily living patterns and occupational routines have changed, resulting in changes in dietary habits, physical activity levels and increased exposure to work-related stressors (Rostami et al., 2024). The behavioral risk factors tend to act together and are interrelated, leading to metabolic disturbances and general poor health status (Kivimäki et al., 2022).

The industrial workers are one of the most vulnerable groups of workers because of the nature of industrial work. Long working hours, shift work, repetitive work, high production demands and different work schedules can have a detrimental effect on workers' physical and mental health (Cunningham et al., 2022). Shift work, which is usually disrupting the normal biological rhythms and daily routines, can impact on eating habits, physical activity patterns and lifestyle practices (Vasconcelos et al., 2023). Convenience foods are often relied on by workers in many industrial environments, and with limited time, workers are often tempted to forgo breakfast or lunch, or spend longer periods sitting during or after their shifts (Teng et al., 2025). On the other hand, work-related factors like fatigue at work and insufficient opportunities for recreation can reduce engagement in regular physical activity (RPAs) (Curran et al., 2023). The behavioural and occupational aspects of all these add significantly to the risk of obesity, metabolic syndrome, hypertension and other lifestyle issues among the industrial population (Ng et al., 2025).

It is now understood that lifestyle related factors are interrelated, and all play a role in metabolic and nutritional health. There are complex physiological and behavioural interactions between dietary behaviour and psychological stress, physical activity and sedentary behaviour. Psychological stress has been correlated with an abnormal functioning of the hypothalamic-pituitary-adrenal axis and an increase in cortisol production, which may result in unhealthy eating patterns and appetite, leading to weight gain (Kivimäki et al., 2022). Levels of stress are also associated with a higher intake of more energy dense foods and unhealthy coping behaviours including reduction in food intake, and eating at irregular times (Nasab et al., 2023). Likewise, physical inactivity, as well as prolonged sedentary behaviours, have been found as independent factors for obesity, insulin resistance, decreased metabolic efficiency and cardiovascular risk (Silveira et al., 2022). Good physical activity, on the other hand, has a positive impact on metabolic health, energy balance and psychological stress (Curran et al., 2023). The patterns of behavior are inter-related and highlight the importance of considering several aspects of lifestyle, rather than one or two variables.

An analysis of individual lifestyle factors in the working populations has been conducted previously, but studies that have included dietary patterns, perceived stress, physical activity, sedentary behaviour and nutritional status in one analysis are limited, particularly in an industry-based setting in a developing country (Nasab et al., 2023). Previous literature has been centered on individual relationships such as the relationship between stress and obesity, or active versus inactive lifestyles and metabolic health, without taking into account the interplay between multiple occupational lifestyle factors (Cunningham et al., 2022). Besides, the size of industrial industries and the nature of occupations has increased in India even though there is a significant increase, but there is very limited evidence in this context. This fragmented awareness is hampering the capacity to develop a comprehensive workplace health intervention to tackle lifestyle disease risk factors and to improve the health of workers.

The present study thus was conducted to explore the relationship between the dietary pattern, perceived stress, physical activity and sedentary behavior with the BMI status among industrial workers. The research also aimed at establishing the prevalence of lifestyle factors, determining the relationship between the factors and nutritional status, and identifying the significant factors that predicted BMI of industrial workers. Awareness of these relationships can be utilised to develop evidence-based occupational health strategies to promote healthy lifestyle behaviours and reduce the burden of lifestyle related disorders among industrial workers.

2. METHODOLOGY

2.1. Study Design

This research study is a quantitative, cross-sectional analytical research study. The cross-sectional design was deemed suitable because it enables the measurement of exposure factors (dietary patterns, stress, physical activity, sedentary behaviour and body mass index) and the outcomes (nutritional status) all in a specific population at a point in time (Javanmardi et al., 2025). Moreover, the analytical element helped to investigate the relationships and possible predictive associations between the variables.

2.2. Study Setting

The research was conducted in specific industrial areas in and around Tamil Nadu, India. These industrial regions include manufacturing, chemical and food processing industries. The employees of such environments are usually both skilled and semi-skilled employees, who are involved in both physically and inactive work (Ding et al., 2023). The number of workers working on rotational shifts, including night shifts, is significant and has been known to affect lifestyle behaviours like meal timing, sleep patterns, and physical activity (Crowther et al., 2022). This setting was chosen because of the presence of a high concentration of industrial establishments and the availability of a heterogeneous workforce, which increased the representativeness of the study population.

2.3. Sample size and selection

Convenience sampling was employed for selecting 410 industrial workers from various of Tamil Nadu's industrial sectors. The criteria were willingness to participate in the study and industrial workers between the ages of 21 to 60. The participants were given distinct identification codes to keep their identities anonymous and to simplify the data management process. The questionnaire was structured in a way that was done using face-to-face interviews so that respondent errors would be minimised and also maximise data completeness. Standardised procedures were used to record anthropometric measurements immediately after the interview (Kaewdok et al., 2022). The methodological framework was well formulated so that it could provide scientific rigour, information reliability, and applicability to the occupational health scenario. The combination of the validated assessment instruments with the data collection in the field improves the trustworthiness of the results and contributes to their usability in the development of specific interventions to offer to industrial workers (Nasab et al., 2023).

2.4. Study Instruments and Measures

Assessment of lifestyle related behaviors and nutritional status of industrial workers was done by using structured and standardised instruments. The instruments chosen were the ones that were valid, reliable and suitable for the field of occupational and public health research (Verbeke et al., 2023).

2.5. Dietary Assessment

Dietary intake patterns were measured with the help of a modified Food Frequency Questionnaire (FFQ) that was developed to measure habitual consumption of food items that were commonly consumed by the study population (Fikadu et al., 2024; Verbeke et al., 2023). Some of the key categories of foods contained in the FFQ were cereals, pulses, fruits, vegetables, dairy products, meat and meat products, fried food, and beverages that are sweetened with sugar. The participants were requested to indicate the frequency of consumption of each food item in the last month.

The categories of frequency were grouped as follows: every day, 3-4 times a week, once a week, occasionally, and never. Through this categorisation, it was possible to distinguish between regular and sporadic patterns of consumption. A scoring system was created to enable a quantitative analysis, with higher scores given to healthier foods, including fruits, vegetables, and whole grains, and lower scores given to the frequent intake of energy-dense and processed foods (Nasab et al., 2023). On the other hand, reverse scoring was used in the case of unhealthy food items. The cumulative dietary score was utilised to categorise the participants into healthy, moderately healthy, and unhealthy dietary patterns. This method has made it possible to simplify and still have an effective assessment of the overall dietary behaviour instead of the individual nutrients.

2.6. Assessment of Perceived Stress

Perceived stress levels were measured using the 10-item Perceived Stress Scale (PSS-10), originally developed by Sheldon Cohen and colleagues. The PSS-10 is a commonly introduced tool to evaluate the extent to which people feel that their lives are unpredictable, uncontrollable, and overwhelming (Hore-Lacy et al., 2024; Milo et al., 2025). The respondents were supposed to tell how frequently they felt and thought about stress within the last month.

All the items were rated using a five-point Likert scale with 0 (never) as one end and 4 (very often) as the other end of the scale, giving a total of 0 to 40. Items with positive statements were reversed and summed up. The levels of stress were classified into low (0- 13), moderate (14 - 26) and high (27 - 40) based on the total score. This standardised tool guaranteed comparability with prior research and increased the validity of stress measurement in the workplace (Hore-Lacy et al., 2024).

2.7. Assessment of Physical Activity and Sedentary Behaviour

The level of physical activity was measured using the Global Physical Activity Questionnaire (GPAQ), which was created by the World Health Organisation. The GPAQ measures the level of physical activity in three areas: work-related activity, transport-related activity, and recreational activity (Ribeiro et al., 2024; Sathish & Mathews, 2023). The participants were requested to provide the frequency (days per week) and the time (minutes per day) of activities undertaken with moderate and vigorous intensity levels. The obtained data were translated into Minutes of Metabolic Equivalent of Task (MET) per week, as per the conventional analysis guidelines of GPAQ. Based on the overall MET scores, subjects were divided into low, moderate and high physical activity levels. This categorisation made it possible to make a standard comparison of the level of activities and their relation to other lifestyle factors and health outcomes.

2.8. Anthropometric Measurements

To determine the nutritional status of the participants, anthropometric measurements were used (Kaewdok et al., 2022). A calibrated digital weighing scale was used to measure body weight with the participants dressed lightly without any shoes. The height was taken by a stadiometer, whereby the participants were in an erect position with the head in Frankfort horizontal position.

BMI = weight (kg) / height² (m^2)

The calculated BMI estimations were categorised in terms of underweight, normal weight, overweight and obese in terms of standard guidelines. These groupings offered an objective assessment of nutritional status and were the main outcome variable to be used in the analysis.

3. DATA COLLECTION PROCEDURE

The data collection process was conducted based on the questionnaires that were administered by the interviewers, to ensure that there is minimal missing data and more completeness in the response. The questionnaire had been pretested with some industrial workers to check the clear understanding of the questionnaire, feasibility and clarity. The required adjustments were made in light of the feedback from the participants and pilot observations.

Participants for the study were recruited in the designated breaks at work and the employee welfare programme sessions at the workplace. Prior to the obtaining of written informed consent, the purpose of the study and procedures were explained. Face-to-face interviews were used for data collection on socio-demographic characteristics, dietary patterns, stress levels, physical activity and sedentary behaviour. The anthropometric measurements were taken immediately after the questionnaire was completed by a standardised measurement procedure (Kaewdok et al., 2022). All data collected were anonymised and kept in a secure manner throughout the research process.

3.1. Statistical Analysis

The statistical package for the social sciences (SPSS) software version 26.0 was used in the data entry, coding and analysis of the data. Socio-demographic, anthropometric, and lifestyle-related variables were summarised using descriptive statistics, which comprised frequencies, percentage, mean and standard deviation. The scales were found to be reliable by using Cronbach's alpha coefficient to test the internal consistency of the study scales. Spearman correlation analysis was used to determine the correlations between BMI and lifestyle factors such as dietary score, stress score, physical activity, sedentary behaviour, age, and work-related factors. The associations among categorical variables (BMI categories and occupational/behavioural factors) were analyzed using chi-square tests.

Multiple linear regression analysis was used to determine who were significant predictors of BMI for industrial workers. Variables that showed significant associations in the preliminary analysis were added to the regression model. For all inferential analyses, $p < 0.05$ was considered to be statistically significant.

4. RESULTS

Table 1: Socio-Demographic Characteristics of Industrial Workers (N = 410).

Variable	Category	Frequency (n)	Percentage (%)
Age Group	21–30 years	118	28.8
	31–40 years	156	38.0
	41–50 years	96	23.4
	>50 years	40	9.8

Gender	Male	278	67.8
	Female	132	32.2
Marital Status	Married	289	70.5
	Unmarried	98	23.9
	Others	23	5.6
Education	Secondary	126	30.7
	Higher Secondary	171	41.7
	Diploma/UG	113	27.6
Work Schedule	Fixed Shift	172	42.0
	Rotational Shift	238	58.0
Work Experience	<5 years	114	27.8
	5–10 years	167	40.7
	>10 years	129	31.5
Monthly Income	<₹20,000	102	24.9
	₹20,000–₹40,000	221	53.9
	>₹40,000	87	21.2

In the present study 410 industrial workers were involved. Table 1 shows the socio-demographic data of the participants. Most of the participants were found in the age group 31-40 followed by the age group 21-30 workers. The majority of the study population were male, which was typical of an industrial population. The majority of the respondents were married while there was a relatively small proportion of unmarried and other marital category respondents.

As far as educational qualification is concerned, significant number of workers had completed secondary and higher secondary education, while very lower number of workers had diploma or under graduation. The occupational profile revealed that a large proportion of the workers had a rotational or shift working pattern, and the remaining workers worked set fixed time periods during the day. There were differences in the length of time participants had been employed by industry – many had worked for over 5 years. Monthly income distribution showed the socioeconomic composition of the industrial workers with more of them falling in the middle-income groups.

The socio-demographic characteristics of the subjects studied show that there is an acceptable range of age, occupational exposure, educational level and work schedules, which serve as a foundation for studying the connection between the lifestyles of industrial workers and their nutritional status

4.1. Anthropometric and Lifestyle Profile

The anthropometric and lifestyle-related characteristics of the study participants are summarised in Table 2 (Teng et al., 2025). The mean body mass index (BMI) was 28.28 ± 6.62 kg/m² among the industrial workers which is indicative of large number of overweight and obese subjects in the study population. BMI categories revealed that most of the workers were obese workers followed by overweight workers.

Table 2 - Anthropometric and Lifestyle Characteristics of Industrial Workers (N = 410).

Variable	Mean ± SD
BMI (kg/m²)	28.28 ± 6.62
Composite Diet Score	31.47 ± 6.28
Composite Stress Score	22.61 ± 5.74
Physical Activity Score	17.82 ± 4.96
Sedentary Time (hours/day)	7.36 ± 2.41
Work Experience (years)	8.92 ± 5.84

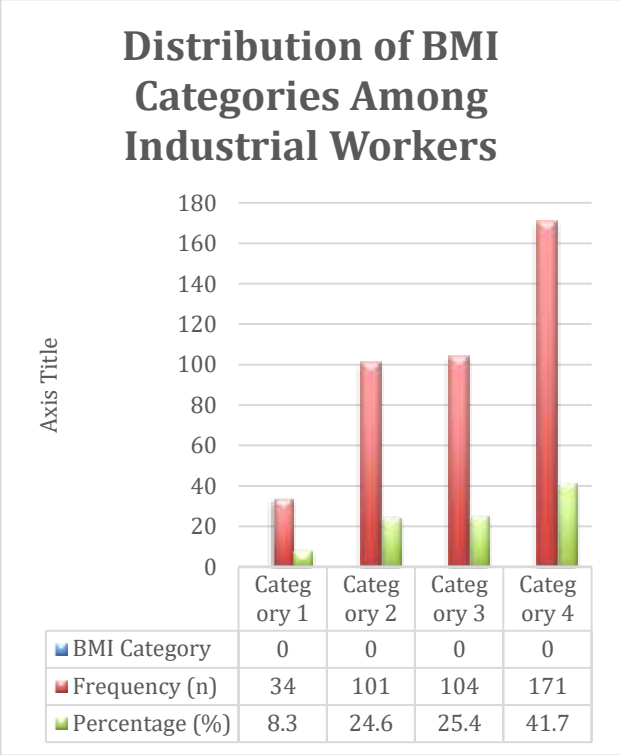

Figure 1. Distribution of BMI Categories Among Industrial Workers

The overall dietary score was found to be at moderate level of compliance with healthy diet in the participants. The mean stress score was used as an indicator of the level of occupational stress in the industrial workforce, which showed moderate levels of occupational stress. Workers had wide range of physical activity scores, which were related to differences between occupational and leisure-time activities. A high proportion of participants still had high levels of sedentary behaviour, including those who had sedentary work or machine-based work. The results also showed that overall, workers who had a rotating schedule tended to have relatively higher levels of stress and sedentary behaviour than workers with a fixed schedule (Silveira et al., 2022).

Those that had better dietary pattern scores and relatively higher physical activity scores had tended to have lower BMI scores.

The overall anthropometric and behavioural data indicate that there are several factors associated with working in the industry and lifestyle which could affect the nutritional status and long-term health of the workers.

The instruments used in this study were subjected to reliability test to check the internal consistency of the instruments. The internal consistency of the dietary assessment scale measured by cronbach's alpha was 0.629 signifying good reliability for assessing diet in industrial workers. The scale comprised 12 items which measured both healthy and unhealthy diets.

4.2. Reliability Analysis

Table 3 - Reliability Analysis of Study Instruments.

Instrument	Number of Items	Cronbach's Alpha	Interpretation
Dietary Assessment Scale	12	0.629	Acceptable
Perceived Stress Scale	10	0.949	Excellent

There was excellent internal consistency for the perceived stress scale with a Cronbach's alpha coefficient greater than the acceptable level for behavioural research. The high reliability value indicates that the items dealing with stress were able to measure occupational and psychological stress consistently in the study participants. Reliabilities obtained suggested that the instruments employed in the present study were appropriate to use for measuring the lifestyle-related and psychosocial variables among industrial workers. The results are consistent with the scoring of the scales for subsequent inferential analyses of the relationships between stress, dietary behaviour, physical activity and nutritional status.

4.3. Correlation Analysis

Spearman correlation analysis was used to analyze the correlation between BMI and lifestyle variables among the industrial workers. Spearman's rho was chosen since some of the variables were ordinal and were not normally distributed.

Table 4. Spearman Correlation Matrix of BMI and Lifestyle Variables (N = 410).

Variables	Spearman rho	p-value
BMI vs Age	0.066	0.180
BMI vs Work Experience	0.198	<0.001
BMI vs Diet Score	-0.330	<0.001
BMI vs Stress Score	0.693	<0.001
BMI vs Physical Activity Score	-0.391	<0.001
BMI vs Sedentary Behaviour	0.615	<0.001

A positive correlation between BMI and perceived stress score was found (rho = 0.693, $p<0.001$), with the workers who reported higher levels of perceived stress having higher BMI scores. The relationship is strong, indicating that stress at work or in the mind could be an important determinant of nutrition among industrial workers. The same has been described in occupational health research that has looked at the impact of chronic stress on metabolic health and obesity-related outcomes (Kivimäki et al., 2022).

Furthermore, BMI was found to have a strong positive correlation with sedentary behaviour (rho = 0.615, $p < 0.001$). Those who reported spending long periods of time sitting had higher BMI values. This is likely to be related to less physical activity and longer sitting times typical of industrial and shift work occupations.

There was a significant negative correlation between BMI and dietary score (rho = -0.330, $p<0.001$). Generally, people with more healthy eating behaviors had lower BMI compared to those with less healthy eating behaviors. The finding is in line with existing evidence which emphasizes the importance of maintaining a balanced diet to achieve healthy body weight and to lower risk factors associated with obesity (Rostami et al., 2024).

Likewise, BMI showed strong negative correlation with the physical activity score (rho = -0.391, $p < 0.001$) which meant that the higher the physical activity score, the lower the BMI score. There is a possibility, then, that enhanced physical activity levels can help to improve the health of industrial workers' weight status.

Strong and statistically significant positive correlation with BMI was seen with work experience (rho = 0.198, $p < 0.001$) suggesting that long duration of work experience might be correlated with steady

BMI increase over a period of time. Contrary to this, there was no statistically significant correlation of BMI with age (rho = 0.066, p = 0.180).

The overall correlation results showed that there were significant relationships among the participants' nutritional status and lifestyle behaviours in industrial workers.

4.4. Association Between BMI Categories and Lifestyle Variables

The association of BMI categories with selected occupation and lifestyle related variables was analysed using chi-square analysis. Summary of the results is given in Table 5.

Table 5. Association Between BMI Categories and Lifestyle Variables.

Variable	χ^2 Value	p-value	Interpretation
Work Schedule	14.72	0.002	Significant
Sedentary Behaviour	38.54	<0.001	Significant
Physical Activity Level	26.41	<0.001	Significant
Stress Category	44.83	<0.001	Significant
Diet Category	18.27	0.005	Significant

There was a significant relation observed between work schedule and BMI category. Individuals who had a work schedule that involved rotating rounds or shifts had a relatively higher proportion of overweight and obese workers compared to those working on fixed daytime work schedules. The shift-based occupational patterns can help to disrupt lifestyle behaviour such as eating and drinking at irregular times of the day, sleeping irregularly and decreasing physical activity.

A significant association was also seen for sedentary behaviour with BMI categories. At the time of the study, there was a higher percentage of overweight and obesity among participants who reported high levels of sedentary time, compared to those who reported low levels of sedentary time. This discovery further reinforces that of an observed positive correlation between sedentary behaviour and BMI. There was a strong association between physical activity level and BMI status. Overall, workers with overweight and obese BMI were more likely to report low levels of physical activity than those with normal BMI. Likewise, there was a statistically significant difference in the BMI categories, with overweight and obese participants more likely to be in the higher stress category.

In addition, dietary category was significantly correlated with BMI status. The participants who had the healthier dietary patterns had relatively low percentages of obesity, while the participants with higher BMI had higher percentages of unhealthy dietary patterns.The chi square results suggest a significant association between occupational schedules and lifestyle related behaviours with nutritional status overall for industrial workers.

4.5. Multiple Regression Analysis

Multiple linear regression analysis was performed to identify the factors affecting BMI of the industrial workers. Age, years of work experience, gender, work schedule, dietary score, stress score, PA score and sedentary behaviour were included as independent variables in the regression model with BMI as the dependent variable.

Table 6. Model Summary for Multiple Linear Regression Analysis.

R	R^2	Adjusted R^2	Std. Error of Estimate
0.710	0.504	0.494	4.70753

Table 7. ANOVA for Multiple Regression Model

Source	Sum of Squares	df	Mean Square	F Value	p-value
Regression	9033.969	8	1129.246	50.957	<0.001
Residual	8886.487	401	22.161		
Total	17920.456	409			

Table 8. Regression Coefficients for Predictors of BMI

Predictor Variable	B	Beta	t-value	Interpretation
Age	-0.143	-0.239	-4.530	Significant
Years of Work Experience	0.179	0.274	5.118	Significant
Gender	-0.066	-0.005	-0.145	Non-significant
Work Schedule	1.181	0.102	2.173	Significant
Diet Score	-1.668	-0.395	-6.529	Significant
Stress Score	3.460	0.395	6.529	Significant
Physical Activity Score	-0.973	-0.162	-3.787	Significant
Sedentary Behaviour	2.310	0.260	4.234	Significant

The regression model had a good explanatory power with the value of R being 0.710 and R^2 being 0.504. The adjusted R^2 value was 0.494, which means that around 49.4% of the variability in BMI can be explained by the variables in the model (Carpi, 2025). For the overall regression model, the ANOVA results indicated that the model was statistically significant ($F = 50.957$, $p < 0.001$), and the selected variables (occupational and lifestyle) were found to be statistically significant in predicting the BMI of industrial workers.

Of the predictor variables, perceived stress score was one that was a very strong positive predictor of BMI (B = 3.460, Beta = 0.395). A positive correlation between stress level and BMI values of workers emerged. BMI was also strongly positively associated with sedentary behaviour (B = 2.310, Beta = 0.260), meaning that high levels of sedentary exposures were linked to higher BMI.

A positive relationship between BMI and years of work experience was found from the years of work experiences as demonstrated by the positive Beta of 0.274 and B of 0.179 respectively (Silveira et al., 2022). However, there was a negative relationship between physical activity score and BMI (B = -0.973, Beta = -0.162), such that the increase in physical activity scores led to the decrease in BMI scores.

The dietary score was also inversely correlated with BMI, with better diets being related to relatively lower BMI values. Work schedule was found to be a positive contributor to the model, showing the importance of work schedule in nutritive outcomes.

Gender was added to the model but did not significantly add to the fit of the model when the other predictor variables were controlled. When analyzed with occupational and behavioural factors, the contribution of age was relatively small when compared to BMI. The regression results suggest that all five factors (stress, sedentary behavior, occupational exposure, dietary behavior, and physical activity) have an effect on BMI for industrial workers. The results justify the relevance of the multi-behavioural and multi-occupational risk factors workplace health promotion strategies.

4.6. DISCUSSION

4.6.1. Overview of Major Findings

The present study investigated the association between dietary habits, perceived stress, physical activity, sedentary activity, and nutrition status of industrial workers. The findings revealed that overweight and obesity were a major health problem affecting the study participants with significant numbers of workers being in the high BMI ranges (Nasab et al., 2023). The average BMI value showed the higher burden of the nutrition related health risk among the industrial workforce.

The results also indicated that perceived stress and sedentary behavior were significantly and positively correlated with BMI while the dietary quality and physical activity were significantly and inversely correlated with BMI. Industrial groups with increased stress and long periods of sitting were more likely to have higher body mass index (BMI). However, those who had healthier dietary habits and more physical activity tended to have a comparatively healthier diet.

The regression analysis was also used to determine that the significant factors affecting the variation of BMI of industrial workers were stress score, sedentary behaviour, work experience and work schedule. The results indicate that both occupational and behavioural factors are associated to the nutritional health in industrial contexts.

The study also elucidated significant relationships between lifestyle related variables. Physical activity was positively associated with healthier dietary behaviour and sedentary behaviour was negatively associated with physical activity and dietary quality. The overall findings showed that a variety of interrelated behavioural and psychosocial factors influence occupational health in the industrial environment and that these factors are not the result of individual lifestyle practices. The observations are consistent with the emerging view that nutrition, physical activity, stress management and work scheduling should all be included together in a workplace health promotion program to enhance employee health.

4.6.2. Dietary Behaviour and BMI

The present study revealed that there was a significant negative correlation of dietary score with BMI which indicated that those with higher dietary scores had lower BIM scores. Those who indicated more positive attitudes about food consumption (eating more fruits, vegetables, and balanced meals) tended to have more positive nutritional disposition while those who indicated less positive attitudes (eating less fruits, vegetables, and meals consumed less frequently) tended to have less positive nutritional disposition.

These results are in line with previous studies of the importance of dietary behavior in the prevalence of overweight and obesity in the workforce. Unhealthy nutrition habits are a major risk factor for metabolic disorders and cardiovascular risks among obesity-related diseases, as noted by (Rostami et al., 2024). Similarly, (Teng et al., 2025) indicated that industrial and shift workers are likely to have an unhealthy diet because they have busy and irregular schedules, and limited access to nutritious food.

Industrial workers may not be able to engage in a normal diet because of their working conditions. Fewer or irregular meals, shorter breaks, cycling shifts, fatigue, and excessive work hours may contribute to eating more processed foods that are higher in calories and less eating. These practices can gradually result in positive energy balance and

weight gain. The present results, therefore, provide some support to the notion that the work setting is a significant influence on nutrition outcomes among industrial workers.

This finding of inverse relationships between dietary score and BMI in the present study is also consistent with findings from occupational health studies which showed better dietary patterns were linked to better metabolic and lower obesity (Ng et al., 2025). Structured eating patterns may also be related to other healthy behaviors, such as physical activity and sleep hygiene, that may affect overall nutrition.

The nutrition-BMI relationship in the present study is similar in various occupational groups and settings, and extends the significance of dietary quality as an easily changeable behaviour in the work environment, which affects nutritional status, particularly among industrial workers.

4.6.2. Stress and Nutritional Status

The major finding of the present study was that there was a positive relationship between perceived stress and BMI. There was a slight tendency for workers with higher stress scores to have higher BMI scores. The regression analysis also revealed that the factors which were the strongest predictors of BMI among the study participants were perceived stress. The findings confirm previous studies that show that chronic work stress is negatively linked to metabolic and behavioral outcomes. Under chronic stress, they explained, the hypothalamic pituitary adrenal (HPA) axis gets activated, resulting in higher cortisol release and impacting the control of appetite, fat storage, and energy metabolism. High levels of cortisol are associated with increased appetite for high fat/high sugar foods, increased central adiposity and weight gain.

Association between stress and nutritional status could also be due to behavioural mechanisms. Stressed employees are more likely to engage in negative coping behaviors like sleep disorders, poor self-care motivation, sedentary lifestyle, emotional eating and changes in eating and drinking patterns. These behaviors, over time, can contribute to an increase in BMI. Furthermore, (Cunningham et al., 2022) have determined a strong association between occupational fatigue and stress, which has a significant impact on the behavioural health outcomes of industrial workers.

The workplace in industry may involve heavy work demands, tight time schedules, repetitive work, production quotas, and variable shifts, which can be a source of psychological stress. One way that shift rotation can contribute to physiological responses to stress is by disrupting circadian rhythms and sleep patterns. In occupational populations, the association between shift work and sleep disturbance and psychological strain is very strong, as found by (Vasconcelos et al., 2023).

The current results echo previous occupational-health related studies which have found associations between psychosocial work factors and behavioral and physiological risk factors for obesity. The poor psychosocial work conditions have been shown to affect the health behaviors of workers and put them at high risk of chronic diseases by (Amoadu et al., 2023).

Finally, the present findings show that occupational stress is one of the factors to consider in the nutritional health of industrial workers. Results emphasize the need for holistic interventions on the job-site focused on stress reduction, psychological supports and behaviour health promotion.

4.6.3. Physical Activity and Sedentary Behaviour

The current study found significant relationships between the physical activity, sedentary behaviour and BMI in industrial workers. Physical activity had a significant inverse association with BMI and sedentary behaviour had a strong positive association with BMI. The workers who reported extended sedentary exposure levels generally had higher BMI, and those who reported higher levels of physical activity levels generally had healthier nutritional profiles. This is in line with earlier studies that have shown physical activity's benefits against obesity and metabolic disorders. Active people tend to exhibit better metabolic control, decreased body fat and decreased obesity risk, according to (Curran et al., 2023). Likewise, industrial employees are less likely to engage in leisure-time physical activity due to high workloads and fatigue at work (Crowther et al., 2022).

Sedentary behaviour (SB) has become a significant occupational health issue, especially in industrial and mechanised occupations. People who sit for long periods of time, monitor machines, repeat actions or have restricted activities may have lower levels of daily energy expenditure. These sedentary work habits can lead to a gradual rise in BMI with metabolic dysfunction over time.

The present study also showed a significant negative correlation between sedentary behaviour and physical activity. In fact, those who reported high levels of physical activity at work felt they were less active in leisure time than the others who

reported being less physically active at work, indicating that the workplace inactivity may spill over into leisure time behaviour. The same results were reported by (Javanmardi et al., 2025) who concluded that low physical activity and sedentary lifestyles are common behaviors among industrial workers. It also indicates that healthier dietary behaviour and physical activity are positively associated, which may imply clustering of health promoting behaviours among workers. Regular physical activity may also lead to increased knowledge about nutrition, body weight and overall health care.

The opportunities for physical activity may also be affected by the occupational structures of industries. Structured exercise in non-working hours may be less likely to be offered by workers who must work long hours, have repetitive work tasks, or undergo shift work, due to fatigue or reduced willingness. Therefore, there is a need for occupational health interventions to encourage the availability of workplace-based physical activity interventions such as active breaks, workplace wellness programmes and ergonomic movement strategies.

In general, the findings have underscored the critical role of physical activity and sedentary behaviours in nutrition status of industrial workers and the importance of adopting comprehensive occupational health promotion programmes.

4.6.4. Occupational Interpretation

The findings with regard to the behaviour and nutrition of the industrial workers in the present study have their background in the occupational context. Work schedules, shift rotations, long working hours, repetitive work, production pressures and fatigue are often features of industrial occupations. These working environments can significantly affect people's diet, stress, sleep, diet-related physical activity and sedentary behaviours.

In the present study, significant association was found with high BMI categories with rotational or night shift schedules. Shift work can affect your normal sleep-wake cycles, hormone levels and your normal eating and sleeping schedule. (Vasconcelos et al., 2023) pointed out that night-shift workers have been found to suffer from sleep disruption, metabolic disruption, and problematic behaviours.

Behavioural changes due to fatigue can also play a part in unhealthy lifestyle in companies. When working for long periods of time, workers can be physically tired and opt for leisure activities that do not involve physical effort, convenience foods, or skipping meals due to lack of time and fatigue. A similar link between work-related fatigue and negative impacts on occupational health behaviours and well-being was reported by (Cunningham et al., 2022).

Occupational factors also play an important role in meal timing, which is a dietary determinant of health. Industrial workers often take their meals at unconventional times, due to their shift rotations and work demands. Skipping meals could affect appetite control, make people more likely to use processed food and affect their metabolic balance. (Teng et al., 2025) found that shift workers often have irregular eating habits and a tendency to eat more energy-dense foods.

There may be further limitations on opportunities for structured physical activity in the industrial setting. Some occupations require physical activity, but there is less variability in movement and/or more repetitive tasks in the workplace that can lead to a reduction in overall movement variability and to longer sedentary time during work. The results of this study, accordingly, highlight the need for work-site-specific health promotion strategies in a work-site context that fit the industrial work environment. Balanced meal schedules, workplace stress management programs, rest breaks, workplace ergonomic design, and physical activity policies and programs can have a significant impact on worker health outcomes as part of organizational policies.

In general, the occupational interpretation of the results indicated that nutritional health is affected by complex, interrelated behavioural, psychosocial and physiological processes in the industrial workplace.

4.6.5. Comparison With Previous Studies

Studies in occupational health among Indians have found that the occupational workers in industries have a high tendency of having irregular food habits and sedentary lifestyle and metabolic disorders. Earlier Indian studies have shown higher rates of obesity in workers in factories and those on shifts, due to unhealthy eating habits and job stress. The present results are therefore in agreement with previous studies which have outlined the nutritional inadequacies of industrial people.

The positive correlation between BMI and stress found was also consistent with literature internationally pertaining to stress and BMI. (Kivimäki et al., 2022) showed that chronic stress can have a great role in the metabolic dysregulation and obesity-related effects via neuroendocrine mechanisms such as cortisol secretion. Similarly, (Amoadu et al., 2023) found that a negative

workplace environment, which is characterized by negative psychosocial factors, has a negative impact on employee behavioural health. The present study's inverse relationship between physical activity and BMI is consistent with the previous studies on relationship between physical activity and occupational health which revealed that physically active workers have healthier metabolic profile. Shift workers have been observed to be limited by factors such as fatigue and work demands on their physical activity and unhealthy behaviour (Crowther et al., 2022).

The current study shows a significant correlation between the amount of sedentary activity and BMI, which is similar to the correlation with BMI in the modern literature on the effects of occupational behavior. (Javanmardi et al., 2025) noted that sedentary exposure for a longer duration among industrial workers can be a crucial factor in increasing the risk of obesity and reducing health status.

Obesity-related nutrition studies also confirm the dietary results of the present study. The authors of (Rostami et al., 2024) pointed out that there is a significant contribution from poor dietary intake and unhealthy food patterns on cardiometabolic risks and obesity prevalence worldwide.

Although the magnitude of associations varies across studies because of differences in occupational settings, sample characteristics, and measurement approaches, the direction of the findings observed in the present study remains highly consistent with existing occupational-health evidence. The present study therefore contributes additional evidence supporting the interconnected influence of occupational, behavioural, and psychosocial factors on nutritional health among industrial workers.

4.6.6. Strengths of the Study

The present study has a number of scientifically and occupation health important strengths (McCurley et al., 2021). The study was comprehensive, as various interconnected lifestyle and occupational factors were analysed within the same model, like dietary behaviour, perceived stress, physical activity, sedentary behaviour and nutritional status. Secondly, the study used validated and standardised instruments related to dietary behaviors, stress and behavioral variables, thus increasing the validity and comparability of the results. Regression analysis carried out enabled more detailed analyses of the individual and combined influence of occupational and behavioural factors on BMI, and the correlation analysis. Another major strength is the relatively large sample size of industrial workers from the environments of occupation where research focusing on lifestyle-related health problems is still relatively limited. The study thus provides valuable contributions to the nutrition literature related to health and the workplace, especially in industrial populations.

5. CONCLUSION

In the present study, the interdependency of dietary patterns, perceived stress, physical activity, sedentary activity and BMI in industrial workers was investigated (Sikora et al., 2022). The results showed that overweight and obesity is prevalent among the study population with a high level of health risk burden associated with lifestyle among the industrial work force. BMI was significantly correlated with various occupational and behavioural factors such as perceived stress, sedentary behaviour, diet, physical activities and the work-related characteristics.

Perceived stress and sedentary behavior showed high positive correlations with BMI; healthier diet pattern and more physical activity were correlated with a relatively low BMI. Multiple regression analysis also revealed that the stress score, sedentary behaviour, work experience, work schedule, dietary behaviour and physical activity significantly explained BMI difference in industrial workers. The results reflect the multi-faceted impact of work- and activity-related factors on nutrition in workplaces. It also highlights the need to take into account the work environment when tackling obesity and metabolic risk in working people. All of these factors can combine to promote unhealthy living habits and obesity in employees (Hou et al., 2025). The results thus corroborate the need for a holistic approach to workplace health promotion including nutrition, stress management, physical activity, and sedentary behaviour.

The study provides valuable information from a public health point of view in relation to the public health determinants of nutritional status in industrial populations. The results can help occupational-health practitioners, employers and policy makers design evidence-based programs to help industrial employees be healthier and lower the lifetime risk of lifestyle-related diseases.

5.1. Recommendations

Some of the key elements of a comprehensive workplace wellness program are a nutrition education program, a stress management program, an exercise promotion program and a reduction in sedentary behaviors among employees. Regular

health screening at work (BMI assessment and lifestyle counselling), however, can assist to detect workers with a high metabolic risk early in their career. Employers should also ensure that planned breaks and providing healthy alternatives in the work canteen and/or employee take-away foods is made easy and simple in the workplace (Ferguson et al., 2023). In addition, industries should promote physical activity programs such as active breaks, stretching breaks, ergonomic movement skills and employee fitness programs at the industry. Stress reduction measures, such as offering counselling, stress-management workshops and employee support systems, could help to support the psychological and nutritional health outcomes. When designing work schedules, considerations should be given to avoid excessive fatigue and disruption of behaviour of workers under a rotational work schedule. Creating occupational environments which support positive health behaviour has the potential to make a big difference to the health of the employee, their productivity, and their long-term health.

Longitudinal and multicentric study designs should be used in future research to shed light on the long-term association of occupational lifestyle factors with nutritional health of industrial workers. Research with a larger and more varied occupational populations can enhance the generalisability of the findings to other industrial situations (Tu et al., 2023). Other factors, such as the amount of sleep, the amount of food consumed, metabolic markers and objective assessment of the physical activity of the employee, should also be taken into consideration in future investigations for a better understanding of what factors impact the employee's health. The qualitative probing of workers' perception of occupational stress, eating habits and behaviour hindering, can also help future studies on workplace health. Intervention-based studies to assess the effectiveness of workplace nutrition programmes, stress-management strategies and physical activity interventions are also recommended as evidence for developing occupational-health plans and policies.

CONFLICT OF INTEREST: Nil

ACKNOWLEDGMENT: The authors thank all the participants of the study for their contribution in data collection.

REFERENCES

Altıntaş-Mutlu, G., & Uçar, A. (2025). Assessment of sustainable and healthy eating behaviors, EAT-lancet diet score, diet quality and obesity indicators among university staff: a cross-sectional study. Journal of Health Population and Nutrition, 44(1), 397. https://doi.org/10.1186/s41043-025-01124-6

Amoadu, M., Ansah, E. W., & Sarfo, J. O. (2023). Influence of psychosocial safety climate on occupational health and safety: a scoping review. BMC Public Health, 23(1), 1344. https://doi.org/10.1186/s12889-023-16246-x

Carpi, M. (2025). The Pittsburgh Sleep Quality Index: a brief review. Occupational Medicine, 75(1), 14–15. https://doi.org/10.1093/occmed/kqae121

Crowther, M. E., Ferguson, S. A., & Reynolds, A. C. (2022). Longitudinal studies of sleep, physical activity and nutritional intake in shift workers: A scoping review. Sleep Medicine Reviews, 63, 101612. https://doi.org/10.1016/j.smrv.2022.101612

Cunningham, T. R., Guerin, R. J., Ferguson, J., & Cavallari, J. (2022). Work-related fatigue: A hazard for workers experiencing disproportionate occupational risks. American Journal of Industrial Medicine, 65(11), 913–925. https://doi.org/10.1002/ajim.23325

Curran, F., Davis, M. E., Murphy, K., Tersigni, N., King, A., Ngo, N., & O'Donoghue, G. (2023). Correlates of physical activity and sedentary behavior in adults living with overweight and obesity: A systematic review. Obesity Reviews, 24(11), e13615. https://doi.org/10.1111/obr.13615

Ding, X., Guan, Z., Liu, N., Bi, M., Ji, F., Wang, H., Zhang, X., Liu, B., Niu, D., Lan, T., Xie, T., Li, J., & Yan, T. (2023). Prevalence and risk factors of work-related musculoskeletal disorders among emerging manufacturing workers in Beijing, China. Frontiers in Medicine, 10, 1289046. https://doi.org/10.3389/fmed.2023.1289046

Ferguson, J. M., Bradshaw, P. T., Eisen, E. A., Rehkopf, D., Cullen, M. R., & Costello, S. (2023). Distribution of working hour characteristics by race, age, gender, and shift schedule among U.S. manufacturing workers. Chronobiology International, 40(3), 310–323. https://doi.org/10.1080/07420528.2023.2168200

Fikadu, W., Mulugeta, S., & Dejene, Y. (2024). Validation of food frequency questionnaire for food intake of adults in Gida, West, Ethiopia. Frontiers in Public Health, 12, 1438008.

https://doi.org/10.3389/fpubh.2024.1438008

Hore-Lacy, F., Gwini, S., Glass, D. C., Dimitriadis, C., Jimenez-Martin, J., Hoy, R. F., Sim, M. R., Walker-Bone, K., & Fisher, J. (2024). Psychometric properties of the Perceived Stress Scale (PSS-10) in silica-exposed workers from diverse cultural and linguistic backgrounds. BMC Psychiatry, 24(1), 181. https://doi.org/10.1186/s12888-024-05613-6

Hou, X., Wang, H., Yang, Z., Jia, Y., Lv, Y., & Dong, X. (2025). Association between physical activity, trouble sleeping, and obesity among older Americans: a cross-sectional study based on NHANES data from 2007 to 2018. BMC Geriatrics, 25(1), 165. https://doi.org/10.1186/s12877-025-05832-w

Javanmardi, S., Rappelt, L., Baumgart, C., Niederer, D., Heinke, L., & Freiwald, J. (2025). Work conditions and determinants of health status among industrial shift workers: a cross-sectional study. Frontiers in Public Health, 12, 1489178. https://doi.org/10.3389/fpubh.2024.1489178

Kaewdok, T., Norkaew, S., Sirisawasd, S., Choochouy, N., & Taptagaporn, S. (2022). Anthropometric measurement of Thai older farmers for agricultural tools and workplace design. Designs, 6(5), 81. https://doi.org/10.3390/designs6050081

Kivimäki, M., Bartolomucci, A., & Kawachi, I. (2022). The multiple roles of life stress in metabolic disorders. Nature Reviews Endocrinology, 19(1), 10–27. https://doi.org/10.1038/s41574-022-00746-8

McCurley, J. L., Levy, D. E., Dashti, H. S., Gelsomin, E., Anderson, E., Sonnenblick, R., Rimm, E. B., & Thorndike, A. N. (2021). Association of Employees' Meal Skipping Patterns with Workplace Food Purchases, Dietary Quality, and Cardiometabolic Risk: A Secondary Analysis from the ChooseWell 365 Trial. Journal of the Academy of Nutrition and Dietetics, 122(1), 110-120.e2. https://doi.org/10.1016/j.jand.2021.08.109

Messineo, L., Bakker, J. P., Cronin, J., Yee, J., & White, D. P. (2024). Obstructive sleep apnea and obesity: A review of epidemiology, pathophysiology and the effect of weight-loss treatments. Sleep Medicine Reviews, 78, 101996. https://doi.org/10.1016/j.smrv.2024.101996

Milo, R. B., Ramira, A., Peppard, S., Ramira, M. L. B., Brown, R., Soon, K., Fontimayor, M., Milo, J. B., & Calero, P. (2025). A Systematic Review of the Non-English Versions of the Perceived Stress Scale (PSS)-10 Psychometric Analysis. SAGE Open Nursing, 11, 23779608251377287. https://doi.org/10.1177/23779608251377287

Nasab, S. J., Hamedani, S. G., Roohafza, H., Feizi, A., Clark, C. C. T., & Sarrafzadegan, N. (2023). The association between dietary patterns and quality of life: a cross-sectional study among a large sample of industrial employees. BMC Public Health, 23(1), 2016. https://doi.org/10.1186/s12889-023-16898-9

Ng, M., Gakidou, E., Lo, J., Abate, Y. H., Abbafati, C., Abbas, N., Abbasian, M., ElHafeez, S. A., Abdel-Rahman, W. M., Abd-Elsalam, S., Abdollahi, A., Abdoun, M., Abdulah, D. M., Abdulkader, R. S., Abdullahi, A., Abedi, A., Abeywickrama, H. M., Abie, A., Aboagye, R. G., . . . Vollset, S. E. (2025). Global, regional, and national prevalence of adult overweight and obesity, 1990–2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. The Lancet, 405(10481), 813–838. https://doi.org/10.1016/s0140-6736(25)00355-1

Ribeiro, M., Fernandes, E., Borges, M., Pires, M., Melo, X., Pinto, F. J., Abreu, A., & Pinto, R. (2024). Reliability and Validity of the Global Physical Activity Questionnaire for Portuguese adults. Perceptual and Motor Skills, 131(5), 1548–1570. https://doi.org/10.1177/00315125241266341

Rostami, R., Moradinazar, M., Moradi, S., Samannejad, B., Cheshmeh, S., Saber, A., & Pasdar, Y. (2024). Impact of dietary risk on global ischemic heart disease: findings from 1990–2019. Scientific Reports, 14(1), 18012. https://doi.org/10.1038/s41598-024-69089-w

Sathish, T., & Mathews, E. (2023). Development of a Modified Global Physical Activity Questionnaire and Its Construct Validity among Adults in Kerala, India. Diabetology, 4(2), 235–242. https://doi.org/10.3390/diabetology4020020

Sikora, M., Sielski, M., Chęciński, M., Chęcińska, K., Czerwińska-Niezabitowska, B., & Chlubek, D. (2022). Patient-Reported Quality of Life versus Physical Examination in Treating Temporomandibular Disorders with Intra-Articular Platelet-Rich Plasma Injections: An Open-Label Clinical Trial. International Journal of Environmental Research and Public Health, 19(20), 13299. https://doi.org/10.3390/ijerph192013299

Silveira, E. A., Mendonça, C. R., Delpino, F. M., Souza, G. V. E., De Souza Rosa, L. P., De Oliveira, C., & Noll, M. (2022). Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis. Clinical Nutrition ESPEN, 50, 63–73.

https://doi.org/10.1016/j.clnesp.2022.06.001

Teng, N. I. M. F., Ngelayang, E., Said, N. M., Juliana, N., Azmi, N. a. S. M., Chen, L., & Loy, S. L. (2025). A qualitative study on nutrition and well-being of healthcare shift workers. Scientific Reports, 15(1), 30512. https://doi.org/10.1038/s41598-025-11534-5

Tu, Z., He, J., Zhai, Q., Zhao, H., Wang, Z., Wang, C., Tian, J., & Shen, X. (2023). Psychometric properties of the Brief Version of Pittsburgh Sleep Quality Index (B-PSQI) among Chinese male sailors on 18-hr rotating shift schedule. Psychological Assessment, 35(12), 1108–1119. https://doi.org/10.1037/pas0001278

Vasconcelos, S. P., Lemos, L. C., & Moreno, C. R. (2023). Night shift work and sleep disturbances in women. Sleep Medicine Clinics, 18(4), 533–543. https://doi.org/10.1016/j.jsmc.2023.06.016

Verbeke, J., Boedt, T., & Matthys, C. (2023). Development and validity of a short web-based semi-quantitative Food Frequency Questionnaire applicable in both clinical and research setting: an evolution over time. Frontiers in Nutrition, 10, 1073559. https://doi.org/10.3389/fnut.2023.1073559

World Health Organization: WHO. (2025, September 25). Noncommunicable diseases. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases