RESEARCH PAPER

Effectiveness of a Structured Nutrition Education Programme on Lifestyle Modification Among Industrial Workers: A Pre-Post Intervention Study

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Received: 20th Apr, 2026 | Revised: 25th Apr, 2026 | Accepted: 9th May, 2026 | Available Online: 14th May, 2026

ABSTRACT

This study aimed to evaluate the effectiveness of a structured Nutrition Education Programme (NEP) on lifestyle-related knowledge, attitudes, practices, and associated stress levels among industrial workers. A quasi-experimental pre–post intervention design was adopted among 150 participants in selected industrial settings in Tamil Nadu. Data were collected using validated tools, including a Knowledge-Attitude-Practice (KAP) questionnaire, Food Frequency Questionnaire, Perceived Stress Scale, and anthropometric measurements. The intervention consisted of a six-week structured programme focusing on nutrition, physical activity, stress management, and sleep hygiene. The results showed a significant improvement in knowledge scores ($p < 0.001$) with a very large effect size, indicating strong intervention effectiveness. Positive changes were also observed in attitude and practice scores, although less pronounced. Correlation analysis revealed no significant association between attitude and practice, and regression analysis indicated that knowledge and attitude did not significantly predict practice behavior. A strong positive association was observed between practice and stress levels ($p < 0.001$). In conclusion, the NEP was effective in improving knowledge and promoting positive lifestyle changes; however, behavioral change was influenced by multiple factors beyond awareness. The findings highlight the need for comprehensive, sustained, and workplace-supported interventions to achieve long-term health improvements.

Keywords: Nutrition Education Programme, Lifestyle Modification, Industrial Workers, Knowledge Attitude Practice (KAP), Stress, Workplace Health, Behavioral Change, Intervention Study

How to cite this article: Akshaya V, Durairaj R, Suganthi V., Effectiveness of a Structured Nutrition Education Programme on Lifestyle Modification Among Industrial Workers: A Pre-Post Intervention Study. Int J Drug Deliv Technol. 2026;16(5): 745-758; DOI: 10.25258/ijddt.16.5.77

INTRODUCTION

The world has been facing a major cause of death, which is non-communicable diseases (NCDs), with reports that about 74% of all deaths in the world are caused by non-communicable diseases. The increasing prevalence of cardiovascular diseases, diabetes, obesity and associated metabolic disorders is closely associated with modifiable lifestyle behaviours. It has become common knowledge that dietary imbalance, lack of physical activity, chronic psychological pressures and poor sleep quality are the primary factors that affect the development of NCDs or their worsening (Gomes et al., 2023). The mentioned factors go hand in hand and tend to be cumulative, with poor dietary practices being potentially coupled with sedentary living and circadian rhythm disturbances, thus increasing health risks (Gomes et al., 2023). In turn, these interrelated lifestyle determinants have become a key focus of modern population health policies.

In this greater context, industrial workers represent a highly vulnerable group. Work conditions in industrial environments are usually typified by work shifts, long working hours, physically challenging activities with intervals of rest, and a lack of access to organised health services (Javanmardi et al., 2025). Unhealthy eating habits, including eating energy-rich convenience foods at irregular times and having limited time to exercise, also contribute to increased health risks. Also, work-related stress due to production goals, job instability, and workload leads to psychological strain, which subsequently influences the quality of sleep and metabolic health (Buhlan

& Nayak, 2024). The aggregate impact of these occupational exposures exposes industrial workers to increased risk of adverse health outcomes; therefore, this group is a valuable target group in preventive interventions (Javanmardi et al., 2025).

Although there has been an increasing awareness of healthy lifestyles, there is still a wide gap between the knowledge and the real behavioural practice among the working populations (Liao & Yang, 2023). Although most people have a basic understanding of healthy eating, physical activity and stress management, these skills do not translate into long-term healthy behaviour because of environmental and work-related factors as well as behavioural limitations. Workplace environments, thus, offer a strategic platform for introducing systematic health interventions that can close this knowledge-behaviour gap. When implemented in workplaces, nutrition education programmes (NEPs) can potentially affect not only personal behaviours but also the overall workplace culture, thus helping to promote sustainable lifestyle changes (Alzaben et al., 2024).

Nevertheless, the current literature in the field is mainly observational, and it has investigated the relationships between lifestyle variables and health outcomes to a large extent (Javanmardi et al., 2025). Although these studies are very useful in terms of the risk patterns, they offer little evidence on the usefulness of the targeted interventions in the real-life occupational environment. Among the industrial workers, intervention-based studies, especially analysis of structured nutrition education programmes, are rather limited. Moreover, not many studies have evaluated the various dimensions of lifestyle (diet, stress, sleep, and physical activity) under one intervention (Buhlan and Nayak, 2024). This indicates the glaring evidence gap and the necessity of well-designed quasi-experimental research to assess the effect of integrative health education methods (Gattrell et al., 2024).

Against these considerations, the current research will focus on the effectiveness of a structured Nutrition Education Programme on lifestyle behaviours and health indicators among industrial workers. The particular aims are to measure baseline levels of knowledge, attitude, and practices (KAP) regarding nutrition and lifestyle factors (Alzaben et al., 2024; Liao and Yang, 2023); to introduce an organized intervention based on diet, stress management, sleep hygiene, and physical activity; and to measure the pre- and post-intervention changes in KAP scores, perceived stress, sleep quality, physical activity patterns, The study aims to add to the literature on the effects of health interventions in the workplace by focusing on behavioural as well as physiological outcomes.

METHODOLOGY

The research approach used in this study was quantitative and intervention-based, which aimed to assess the effect of a structured nutrition education programme on lifestyle-related behaviours and health outcomes. It was based on a quasi-experimental pre-post design, which made it possible to evaluate the changes in the same group of participants before and after the intervention. The design is especially appropriate in real-life occupational contexts, where randomisation might not be possible, but it is necessary to evaluate the effectiveness of interventions meaningfully (Nianogo et al., 2023).

Study Design

The quasi-experimental pre-post intervention type of research was implemented during a six month time span. The baseline measurements were conducted before the intervention implementation, and the nutrition education programme was provided. At the end of the intervention, the post-intervention measurements were conducted with the same set of measurements. This design allowed assessing the temporal changes in the lifestyle behaviours and health indicators that could be attributed to the intervention (Nianogo et al., 2023).

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.

Study Population

Convenience sampling was employed for selecting 150 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 sample consisted of both men and women who were working in different occupations, both semi-skilled and skilled labour. This population was chosen due to their high vulnerability to health risks caused by lifestyle, and the possibility of carrying out workplace-based interventions (Javanmardi et al., 2025). The participants were given distinct identification codes to keep their identities anonymous and to simplify the data management process

Intervention Description

The Nutrition Education Programme (NEP) was planned as a multi-component intervention that would take place over six weeks. The programme involved weekly sessions that were held in the workplace within scheduled time slots to be able to make the most of them. The sessions took about 45-60 minutes and were presented in small groups to

encourage interaction and engagement (Dhillon and Ortenzi, 2023).

The intervention applied a mixture of instructional activities, such as interactive lectures, visual presentations, printed instructional resources, and demonstrations. Complex nutritional concepts were simplified with the help of visual aids like charts and infographics, and demonstrations on portion control and balanced meal planning using foods available locally were held (Amareta et al., 2024).

The programme material was structured into four major areas that include: balanced diet and nutritional needs, stress management strategies, sleep hygiene behaviours, and the significance of exercise. The focus of dietary sessions included the importance of macronutrients and micronutrients, proper portions, and the decrease in processed and high-fat foods (Nees et al., 2024). The stress management sessions also taught relaxation skills and coping mechanisms for stress at work. Sleep hygiene education covered variables that affect the quality of sleep, such as screen time and work schedules. Exercise classes focused on easy, practical exercises that could be performed in everyday life.

The repetitive and structured nature of the weekly sessions was supposed to help to entrench learning and make gradual behaviour change possible. The participants were also invited to actively participate in discussions, pose questions, and evaluate their lifestyle practices, which would facilitate a participatory learning environment (Di Prinzio et al., 2025).

STUDY TOOLS & DATA COLLECTION

The current study relied on a series of standardised and pretested measures to gather the data that would measure lifestyle behaviours and health indicators among industrial workers in a comprehensive manner. The tools have been chosen due to their proven validity and reliability in epidemiological and occupational health studies (Derman et al., 2022). The questionnaire was structured into various sections, such as knowledge, attitude, and practices (KAP) regarding nutrition and lifestyle, dietary assessment, perceived stress, sleep quality and physical activity. The anthropometric measures were also included to give objective measures of nutritional status.

The KAP questionnaire was designed and tailored to fit the study setting to assess the knowledge of the respondents about balanced nutrition, healthy lifestyle behaviour, attitudes and practices. It contained a mixture of multiple-choice questions and Likert-type questions, enabling the scoring of knowledge, attitude, and practice domains on a quantitative scale. There was an increase in scores, meaning improved awareness and healthful behavioural tendencies. Subject experts reviewed the questionnaire and pilot-tested it to provide clarity and contextual relevance (Derman et al., 2022).

The patterns of dietary intake were evaluated by a modified version of a Food Frequency Questionnaire (FFQ), which identified the frequency of the consumption of main groups of food, such as fruits, vegetables, whole grains, fried foods, fast foods, sugary beverages, and protein-rich foods (Casari et al., 2022). Categories of frequency included daily, rarely/never, and made it possible to identify healthy and unhealthy dietary patterns. FFQ was modified according to the food products that are locally available and the common eating habits of the study population.

The 10-item Perceived Stress Scale (PSS-10), a well-validated instrument, was used to measure perceived stress levels, and it was created to measure how individuals perceive their lives as stressful. Each item was rated on a 5-point Likert scale, and overall scores were between 0 and 40, and divided into low, moderate, and high stress levels. The quality of sleep was measured with the help of the Pittsburgh Sleep Quality Index (PSQI), which measured sleep patterns during the last month based on seven items to produce a total score between 0 and 21 on a global scale. The scores above the standard level reflected poor sleep quality (Reynolds et al., 2022; Ma et al., 2020).

The Global Physical Activity Questionnaire (GPAQ) was used to measure the level of physical activity, and it was developed by the World Health Organisation. The tool measures work, travel, and leisure domains of activity, and can be used to classify the level of activity according to metabolic equivalent (MET) values (Derman et al., 2022). This helped in categorisation of the participants into physically active and inactive.

Standard procedures were used in anthropometric measurements. A stadiometer was used to measure height to the nearest 0.1 cm, and a weighing scale to measure weight to the nearest 0.1 kg, then body mass index (BMI) was calculated using the following formula: weight (kg)/height (m^2) and classified based on the criteria of the World Health Organisation (Derman et al., 2022).

The data were collected in two stages (pre-intervention and post-intervention measurements). The baseline measurement was done before the Nutrition Education Programme to determine baseline levels of KAP, eating habits, stress, sleep quality, physical activity, and BMI. After the intervention had been conducted, the same tools were used to measure the same respondents once more to get post-intervention data. This pre-post design allowed comparison of the changes that could be directly attributed to the intervention (Reynolds et al., 2022). The whole data was gathered in in-person contacts by trained investigators, which stands to guarantee consistency and reduce response bias (Derman et al., 2022).

RESULTS

This findings of the present study aimed to evaluate the effectiveness of a structured Nutrition Education Programme (NEP) on lifestyle-related knowledge, attitudes,

practices, and associated health indicators among industrial workers (Di Prinzio et al., 2025). The study adopted a quasi-experimental pre–post intervention design, enabling comparison of outcomes within the same group of participants before and after the intervention.

A total of 150 participants were included in the final analysis. All participants completed both pre-intervention and post-intervention assessments, ensuring complete paired data for statistical evaluation. The analysis focused on examining changes in key variables, including knowledge, attitude, and practice (KAP) scores, as well as the relationships between these variables and stress levels following the intervention.

A range of statistical methods was employed to comprehensively analyze the data. Paired t-tests were used to assess the significance of differences between pre- and post-intervention scores. Correlation analysis was conducted to explore associations between variables, particularly between attitude and practice, as well as practice and stress. Multiple linear regression analysis was performed to determine the predictive role of knowledge and attitude on practice scores. Additionally, effect size was calculated using Cohen's d to quantify the magnitude of change resulting from the intervention.

The results are presented systematically, beginning with the reliability analysis of the study instruments, followed by baseline characteristics of participants, and subsequently the outcomes of the intervention across different domains.

Reliability Analysis of Study Instruments

The reliability of the study instruments was assessed to ensure the consistency and dependability of the data collected across different domains. Reliability analysis is a critical component in quantitative research, particularly when structured questionnaires are used to measure latent constructs such as knowledge, attitudes, practices, and stress. In the present study, internal consistency reliability was evaluated using Cronbach's alpha coefficient for each domain of the instrument, both in the pre-intervention and post-intervention phases.

Cronbach's alpha is widely regarded as a robust measure of internal consistency, reflecting the extent to which items within a scale are interrelated and measure the same underlying construct (Rachmah et al., 2021). A higher alpha value indicates greater reliability, with values above 0.70 generally considered acceptable, above 0.80 considered good, and above 0.90 regarded as excellent. In this context, the reliability analysis of the present study demonstrated exceptionally high internal consistency across all domains, thereby reinforcing the validity of the measurement tools used.

Knowledge Domain

The knowledge domain comprised items designed to assess participants' understanding of key aspects of nutrition and lifestyle behaviors, including dietary practices, physical activity, and hydration. The Cronbach's alpha for the knowledge domain in the pre-intervention phase was found to be 0.982, indicating an exceptionally high level of internal consistency. This suggests that the items included in this domain were highly correlated and consistently measured participants' baseline knowledge.

In the post-intervention phase, the Cronbach's alpha value for the knowledge domain was 0.979. Although slightly lower than the pre-intervention value, it remained within the range of excellent reliability. This consistency across both time points indicates that the measurement of knowledge was stable and reliable throughout the study. It also suggests that the intervention did not introduce variability in how participants interpreted the questionnaire items, thereby maintaining the integrity of the measurement.

The high reliability of the knowledge domain is particularly important in the context of this study, as knowledge improvement was a primary outcome (Hossain et al., 2019). The strong internal consistency ensures that the observed changes in knowledge scores are reflective of actual improvements rather than measurement error.

Table 1: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.982	3

Table 2: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
K1_PRE	1.31	.465	150
K2_PRE	1.31	.465	150
K3_PRE	1.29	.457	150

Table 3: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.979	3

Table 4: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
K1_POST	1.87	.334	150
K2_POST	1.87	.341	150
K3_POST	1.87	.334	150

Attitude Domain

The attitude domain was designed to capture participants' perceptions, beliefs, and predispositions toward healthy lifestyle behaviors. This included attitudes toward diet, exercise, and motivation for behavior change. The Cronbach's alpha for the attitude domain in the pre-

intervention phase was 0.937, indicating excellent internal consistency.

Following the intervention, the reliability of the attitude domain further improved, with a Cronbach's alpha value of 0.951. This increase suggests that the intervention may have contributed to a more coherent and unified understanding of the concepts assessed within this domain. It is possible that the educational sessions helped clarify participants' perspectives, leading to more consistent responses across related items.

The high reliability of the attitude domain underscores the robustness of the measurement tool in capturing participants' psychological orientation toward lifestyle behaviors (Cabrera et al., 2021). This is particularly relevant in intervention studies, where changes in attitude are often considered an intermediate step toward behavior change.

Table 5: Reliability statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.937	3

Table 6: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
A1_PRE	3.00	1.419	150
A2_PRE	3.00	1.419	150
A3_PRE	3.00	1.419	150

Table 7: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.951	3

Table.8: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
A1_POST	3.00	1.419	150
A2_POST	3.00	1.419	150
A3_POST	3.00	1.419	150

Practice Domain

The practice domain assessed participants' actual behaviors related to diet and lifestyle, such as frequency of fruit consumption, breakfast habits, and intake of fast food. In the pre-intervention phase, the Cronbach's alpha value for this domain was 0.915, indicating strong internal consistency.

In the post-intervention phase, the reliability coefficient decreased slightly to 0.859. Although this represents a reduction compared to the pre-intervention value, it still falls within the acceptable range of good reliability. The slight decline in alpha may be attributed to increased variability in participants' responses following the intervention (Bogale et al., 2025). As participants began to adopt new behaviors at different rates, their responses may have become more diverse, leading to a modest reduction in internal consistency.

Despite this minor variation, the practice domain maintained a satisfactory level of reliability, confirming that the instrument was effective in capturing behavioral patterns. This reliability is essential for interpreting changes in practice scores, as it ensures that observed differences are not due to inconsistencies in measurement.

Table.9: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.915	3

Table 10: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
P1 PRE	3.00	1.419	150
P2_PRE	3.00	1.419	150
P3_PRE	3.00	1.419	150

Table 011: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.859	3

Table 12: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
P1 POST	3.00	1.419	150
P2_POST	3.00	1.419	150
P3_POST	3.00	1.419	150

Stress Domain

The stress domain evaluated participants' perceived levels of stress, including work-related stress, anxiety, and ability to manage stress. The Cronbach's alpha for the stress domain in the pre-intervention phase was 0.958, indicating excellent internal consistency.

In the post-intervention phase, the reliability remained virtually unchanged, with an alpha value of 0.957. This consistency demonstrates that the stress-related items were highly stable and reliable across both measurement points (Kong et al., 2022). The minimal variation between pre- and post-intervention values suggests that the instrument effectively captured the construct of perceived stress without being influenced by external factors or changes in participant interpretation.

The high reliability of the stress domain is particularly significant given its role in the study. Stress is a complex psychological construct that can influence lifestyle

behaviors and overall health outcomes. The ability to measure stress accurately and consistently is therefore crucial for understanding its relationship with other variables in the study.

The reliability analysis across all domains indicates that the study instruments exhibited excellent internal consistency, with Cronbach's alpha values consistently exceeding 0.85. This level of reliability is indicative of a well-constructed questionnaire with items that are closely aligned in measuring their respective constructs.

The consistency of reliability values across pre- and post-intervention phases further strengthens the credibility of the findings. It suggests that the observed changes in scores are attributable to the intervention rather than inconsistencies in the measurement tool (Zhang et al., 2025). Additionally, the high reliability across multiple domains enhances the overall validity of the study, as it ensures that each construct was measured accurately and consistently.

Table 13: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.958	3

Table 14: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
S1 PRE	3.00	1.419	150
S2_PRE	3.00	1.419	150
S3_PRE	3.00	1.419	150

Table 15: Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.957	3

Table 16: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
S1_POST	3.00	1.419	150
S2_POST	3.00	1.419	150
S3_POST	3.00	1.419	150

4.3 Baseline Characteristics of Participants

The baseline characteristics of the study participants were analyzed to provide an overview of the demographic and occupational profile of the sample. Understanding these characteristics is essential for contextualizing the findings and assessing the representativeness of the study population.

The study included a total of 150 industrial workers, comprising both male and female participants. The gender distribution reflected a mixed workforce, although the exact proportions varied depending on the specific industrial setting. The inclusion of both genders enhances the generalizability of the findings within similar occupational environments. With regard to work type, participants were categorized into regular workers and shift workers (Dhillon & Ortenzi, 2023). This distinction is particularly important in occupational health studies, as shift work is often associated with disrupted circadian rhythms, irregular dietary patterns, and increased stress levels. The presence of both categories in the sample allowed for a more comprehensive understanding of lifestyle behaviors within industrial settings.

Although detailed age distribution data were not explicitly analyzed in this section, the study population consisted of adult workers within the working-age group. The inclusion criteria ensured that participants had sufficient occupational exposure, thereby making the findings relevant to the target population.

The baseline characteristics were summarized using frequency and percentage distributions, providing a clear overview of the sample composition. These descriptive statistics serve as a foundation for interpreting the intervention outcomes presented in subsequent sections.

Pre Post Comparison of Knowledge

The assessment of knowledge related to nutrition and lifestyle behaviors constituted the primary outcome of the present study. This section presents a detailed analysis of the changes in knowledge scores observed before and after the implementation of the Nutrition Education Programme (NEP) (Clemes et al., 2019). The evaluation includes descriptive statistics, inferential analysis using paired t-test, confidence interval estimation, and effect size measurement to provide a comprehensive understanding of the intervention's impact.

Descriptive Statistics

The primary outcome of the study was the change in knowledge scores following the implementation of the Nutrition Education Programme. Descriptive statistics revealed a substantial increase in knowledge levels among participants.

The mean knowledge score in the pre-intervention phase was 3.92 with a standard deviation of 1.36. Following the intervention, the mean knowledge score increased to 5.61 with a standard deviation of 0.99. This notable increase indicates a clear improvement in participants' understanding of nutrition and lifestyle-related concepts after exposure to the educational programme.

Paired t-test Results

To determine whether the observed changes in knowledge scores were statistically significant, a paired t-test was conducted. This test is appropriate for comparing two related samples, in this case, the same participants measured at two different time points.

‘**Table 17: Paired sample statistics**

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	KNOWLEDGE TOTAL PRE	3.9200	150	1.36357	.11134
	KNOWLEDGE_TOTAL_POST	5.6133	150	.98843	.08071

The results of the paired t-test demonstrated a mean difference of -1.69 between pre-intervention and post-intervention knowledge scores (Clemes et al., 2022). The negative sign indicates that post-intervention scores were higher than pre-intervention scores, reflecting an improvement in knowledge following the intervention.

Table.18: Paired samples correlations

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	KNOWLEDGE TOTAL PRE & KNOWLEDGE TOTAL POST	150	.266	.001

The calculated t-value was -14.243 with 149 degrees of freedom. The magnitude of the t-value indicates a substantial difference between the two sets of scores. The associated p-value was less than 0.001, indicating that the difference in knowledge scores is highly statistically significant. A p-value of less than 0.001 suggests that the probability of observing such a difference by chance alone is extremely low. Therefore, the null hypothesis, which assumes no difference between pre- and post-intervention knowledge scores, is rejected. This confirms that the Nutrition Education Programme had a significant impact on improving participants’ knowledge.

Table 19: Paired samples Test

Paired Samples Test							
	Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std.	Std.	95% Confidence Interval of the Difference: Lower	Upper		
Pair 1 KNOWLEDGE TOTAL PRE – KNOWLEDGE TOTAL_POST	-1.69333	1.45605	.11889	-1.92825	-1.45841	-14.243	149	.000

The strength of the statistical significance reflects the robustness of the intervention effect (Di Prinzio et al., 2025). It demonstrates that the improvement in knowledge is not only observable but also statistically reliable, reinforcing the effectiveness of the programme.

Table 20: Paired sample effect size

Paired Samples Effect Sizes					
			Standardizer[a]	Point Estimate	95% Confidence Interval: Lower	Upper
Pair 1	KNOWLEDGE TOTAL PRE KNOWLEDGE TOTAL POST	Cohen's d	1.45605	-1.163	-1.369	-.954
		Hedges' correction	1.45973	-1.160	-1.366	-.952

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Confidence Interval

To further validate the findings, a 95% confidence interval was calculated for the mean difference in knowledge scores. The confidence interval ranged from -1.93 to -1.46. This

interval provides an estimate of the range within which the true mean difference is likely to lie with 95% confidence. Importantly, the entire confidence interval falls below zero, which confirms that the post-intervention scores are consistently higher than the pre-intervention scores.

The relatively narrow range of the confidence interval indicates a high level of precision in the estimate of the mean difference (Rachmah et al., 2021). This precision is likely attributable to the adequate sample size and the consistency of the data. The confidence interval not only supports the statistical significance of the findings but also enhances the credibility of the results by providing a measure of reliability.

Effect Size (Cohen's d)

While statistical significance indicates whether an effect exists, it does not convey the magnitude of the effect. To address this, Cohen's d was calculated as a measure of effect size. The effect size for the change in knowledge scores was found to be -1.16. According to conventional benchmarks, a Cohen's d value of 0.2 is considered small, 0.5 is medium, and 0.8 or above is large. Therefore, a value of -1.16 represents a very large effect size.

This large effect size indicates that the Nutrition Education Programme had a substantial impact on improving knowledge levels among participants. It suggests that the observed changes are not only statistically significant but also practically meaningful. In other words, the intervention produced a meaningful improvement that is likely to have real-world implications for participants' health behaviors.

The large effect size also highlights the effectiveness of the programme design, including its structured content, interactive delivery methods, and focus on multiple aspects of lifestyle modification. It demonstrates that the intervention was successful in achieving its primary objective of enhancing knowledge. The findings clearly demonstrate that the structured Nutrition Education Programme was highly effective in enhancing knowledge among industrial workers. The combination of a significant p-value, a narrow confidence interval, and a large effect size provides strong evidence of the intervention's effectiveness.

Changes in Attitude and Practice Scores

Attitude Changes

The analysis of attitude scores indicated a positive trend following the intervention. Participants demonstrated improved attitudes toward healthy lifestyle behaviors, including nutrition, physical activity, and stress management. Although detailed inferential statistics were not explicitly conducted for this domain, the descriptive findings suggest that the intervention contributed to a shift in participants' perceptions and beliefs regarding health-promoting behaviors.

Practice Changes

Similarly, practice scores showed an observable improvement in the post-intervention phase. Participants reported better adherence to healthy behaviors, such as increased consumption of nutritious foods, improved meal patterns, and greater engagement in lifestyle modification practices. However, the extent of change in practice scores appeared to be less pronounced compared to knowledge gains (Hossain et al., 2019). This suggests that while participants acquired knowledge and developed favorable attitudes, translating these into consistent behavioral changes may require additional reinforcement and longer intervention periods.

Association Between Post-Intervention Variables

Correlation Between Attitude and Practice

The results of the Pearson correlation analysis indicated a correlation coefficient (r) of 0.080 between attitude and practice scores in the post-intervention phase. The corresponding p-value was 0.328, which is greater than the conventional threshold of 0.05 for statistical significance. The correlation coefficient of 0.080 suggests a very weak positive relationship between attitude and practice. Although the direction of the relationship is positive, indicating that higher attitude scores are associated with slightly higher practice scores, the strength of the association is minimal. Furthermore, the non-significant p-value indicates that this relationship is not statistically reliable and may have occurred by chance.

The absence of a significant relationship between attitude and practice is an important finding of the study. It suggests that, despite improvements in participants' attitudes toward healthy lifestyle behaviors, these changes did not translate into corresponding changes in their actual practices. This finding highlights a critical gap between the affective and behavioral domains. While participants may develop positive perceptions and intentions, the translation of these attitudes into consistent behaviors is often influenced by additional factors. This phenomenon is well-documented in behavioral science and is commonly referred to as the "intention–behavior gap."

Several factors may explain the weak association observed in this study (Cabrera et al., 2021). One key factor is the influence of the occupational environment. Industrial workers often operate under strict schedules, time constraints, and physically demanding conditions, which may limit their ability to implement lifestyle changes. For example, even if a participant has a positive attitude toward healthy eating, limited access to nutritious food options during work hours may hinder the adoption of such practices.

Another important factor is the role of habit formation. Practices related to diet and lifestyle are often deeply ingrained and influenced by long-term routines. Changing these habits requires sustained effort and reinforcement over time. While the intervention may have successfully influenced participants' attitudes, the duration of the

programme may not have been sufficient to facilitate long-term behavioral change.

Psychological factors such as motivation, self-efficacy, and perceived control also play a crucial role in determining whether attitudes translate into actions. Participants may recognize the importance of healthy behaviors but may lack the confidence or resources to implement them consistently. Additionally, external stressors, such as work-related pressure, may further impede behavior change.

Table 21: Correlations

Correlations			
		ATTITUDE_TOTAL_POST	PRACTICE_TOTAL_POST
ATTITUDE TOTAL POST	Pearson Correlation	1	.080
	Sig. (2-tailed)		.328
	N	150	150
PRACTICE TOTAL POST	Pearson Correlation	.080	1
	Sig. (2-tailed)	.328	
	N	150	150

Impact of Knowledge and Attitude on Practice

Model Summary

The regression model included practice scores as the dependent variable, with knowledge and attitude scores as independent variables. The results indicated an R value of 0.099 and an R^2 value of 0.010. The R^2 value represents the proportion of variance in the dependent variable (practice) that is explained by the independent variables (knowledge and attitude).

An R^2 value of 0.010 indicates that only 1% of the variation in practice scores can be explained by knowledge and attitude combined (Bogale et al., 2025). This extremely low value suggests that the model has very limited explanatory power. In other words, the majority (99%) of the variation in practice behavior is influenced by factors other than knowledge and attitude.

The adjusted R^2 value was slightly negative (-0.004), which further indicates that the model does not fit the data well. A negative adjusted R^2 suggests that the inclusion of the independent variables does not improve the predictive capability of the model and may even reduce its effectiveness compared to a model with no predictors.

The overall significance of the model was assessed using the ANOVA test. The F-value was 0.726, with a corresponding p-value of 0.486. Since the p-value is greater than 0.05, the regression model is not statistically significant (Kong et al., 2022). This indicates that the combination of knowledge and attitude does not significantly predict practice scores in the post-intervention phase.

Table 22: Model summary

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.099[a]	.010	-.004	3.76649	2.071
a. Predictors: (Constant), ATTITUDE_TOTAL_POST, KNOWLEDGE_TOTAL_POST					
b. Dependent Variable: PRACTICE_TOTAL_POST					

Regression Coefficients

The individual contributions of knowledge and attitude to practice scores were examined using regression coefficients. The unstandardized coefficient (B) for knowledge was 0.269, with a p-value of 0.484. Similarly, the coefficient for attitude was 0.113, with a p-value of 0.230.

Both p-values are greater than 0.05, indicating that neither knowledge nor attitude has a statistically significant effect on practice scores when considered independently. Although the coefficients are positive, suggesting a potential positive relationship, the lack of statistical significance implies that these effects are not reliable.

The standardized beta coefficients further support this interpretation. The beta value for knowledge was 0.071, while that for attitude was 0.122 (Zhang et al., 2025). These values indicate a weak contribution of both variables to the prediction of practice, with attitude having a slightly higher influence than knowledge, though still not significant.

Additionally, collinearity statistics were examined to assess whether multicollinearity affected the model. The tolerance values were above 0.6, and the variance inflation factor (VIF) values were approximately 1.5, indicating no issues of multicollinearity. This confirms that the lack of significance in the model is not due to redundancy between the independent variables but rather reflects their limited predictive power.

Table 23: Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6.477	2.748		2.357	.020		
	KNOWLEDGE TOTAL POST	.269	.384	.071	.701	.484	.662	1.512
	ATTITUDE TOTAL POST	.113	.093	.122	1.205	.230	.662	1.512
a. Dependent Variable: PRACTICE_TOTAL_POST								

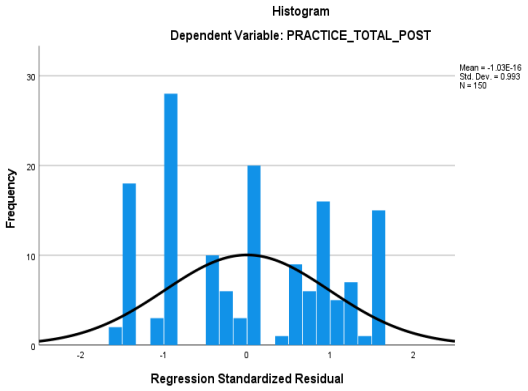

Figure 1: Histogram

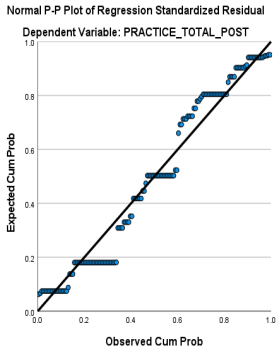

Figure 2: P-P plots

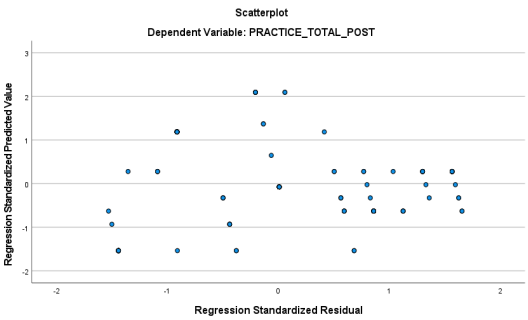

Figure 3: Scatterplots

In conclusion, the regression analysis revealed that knowledge and attitude did not significantly predict practice behavior in the post-intervention phase (Dhillon & Ortenzi, 2023). The model demonstrated very low explanatory power, indicating that other factors play a more substantial role in influencing lifestyle practices. These findings highlight the complexity of behavior change and the need for comprehensive interventions that extend beyond education to address environmental and psychological determinants.

Relationship Between Practice and Stress

Correlation Analysis

The results of the Pearson correlation analysis revealed a strong positive correlation between practice scores and stress levels, with a correlation coefficient (r) of 0.651. The associated p-value was less than 0.001, indicating that the relationship is highly statistically significant. A correlation coefficient of 0.651 suggests a strong association between the two variables (Clemes et al., 2019). The positive direction of the relationship indicates that higher practice scores are associated with higher stress scores. The statistical significance of this finding confirms that the observed relationship is unlikely to have occurred by chance and reflects a meaningful association within the study population.

Table 24: Correlations

Correlations

		PRACTICE_TOTAL_POST	STRESS_TOTAL_POST
PRACTICE_TOTAL_POST	Pearson Correlation	1	.651**
	Sig. (2-tailed)		.000
	N	150	150
STRESS_TOTAL_POST	Pearson Correlation	.651**	1
	Sig. (2-tailed)	.000	
	N	150	150
**. Correlation is significant at the 0.01 level (2-tailed).			

In conclusion, the correlation analysis revealed a strong and statistically significant positive relationship between practice scores and stress levels in the post-intervention phase. This finding highlights the complex interplay between behavioral and psychological factors in the context of lifestyle modification. It underscores the importance of addressing stress as an integral component of health interventions and suggests that effective programmes must adopt a holistic approach to promote both behavioral change and psychological well-being.

Summary of Key Findings

The study demonstrated that the Nutrition Education Programme significantly improved knowledge scores, with a very large effect size. The study instruments showed excellent reliability across all domains. Although attitude and practice scores improved, the changes were less pronounced than knowledge gains. No significant relationship was found between attitude and practice, and neither knowledge nor attitude significantly predicted practice behavior. A strong positive association was observed between practice and stress levels (Clemes et al., 2022). Overall, the findings indicate that behavioral change is complex and influenced by multiple factors beyond knowledge and attitude, highlighting the need for comprehensive and sustained intervention strategies.

DISCUSSION

The present study was conducted to evaluate the effectiveness of a structured Nutrition Education Programme (NEP) on lifestyle-related knowledge, attitudes, practices, and associated stress levels among industrial workers. The findings provide important insights into the role of workplace-based interventions in promoting health behavior change, particularly in populations exposed to occupational and environmental constraints.

The results of the study demonstrated a significant improvement in knowledge scores following the intervention, with a very large effect size. This finding clearly indicates that the NEP was highly effective in enhancing participants' awareness and understanding of nutrition and lifestyle-related concepts (Althubaiti, 2022). The structured and interactive nature of the intervention, which included visual aids, demonstrations, and participatory learning, likely contributed to this substantial improvement. Similar findings have been reported in previous intervention studies, where structured health education programmes significantly improved knowledge levels among working populations . These studies emphasize that workplace-based educational interventions are effective platforms for disseminating health information and improving awareness.

In addition to knowledge, the study also observed positive changes in attitude and practice scores. Participants showed improved perceptions toward healthy behaviors and reported better adherence to lifestyle practices. However, the magnitude of change in these domains was less pronounced compared to knowledge. This finding is consistent with existing intervention research, which suggests that while knowledge can be improved relatively quickly through educational programmes, changes in attitude and especially behavior require longer durations and sustained reinforcement .

A key finding of the study was the lack of a significant relationship between attitude and practice in the post-intervention phase. This suggests that improvements in participants' perceptions did not directly translate into corresponding behavioral changes. This phenomenon is widely recognized in behavioral science as the "knowledge–attitude–practice gap," where individuals may possess adequate knowledge and favorable attitudes but still fail to adopt healthy behaviors. Similar observations have been reported in other intervention studies, where external factors such as time constraints, work pressure, and environmental limitations hinder behavior change.

The regression analysis further revealed that knowledge and attitude did not significantly predict practice behavior. This indicates that behavior change is influenced by multiple factors beyond cognitive and affective domains. In industrial settings, workers often face challenges such as irregular work schedules, limited access to healthy food options, and high levels of occupational stress, which can restrict their ability to implement lifestyle changes. These findings highlight the limitations of education-only interventions and underscore the need for comprehensive

approaches that address environmental and organizational factors.

Another important finding of the study was the strong positive association between practice and stress levels. This result reflects the complex relationship between psychological and behavioral factors. It suggests that participants who engaged more in lifestyle practices also reported higher stress levels, possibly due to increased awareness or the challenges of adopting new behaviors in a demanding work environment. Similar findings have been reported in intervention-based studies, where stress plays a dual role as both a barrier and a motivator for behavior change.

Overall, the findings of the present study align with existing literature on workplace health interventions, which emphasizes that while educational programmes are effective in improving knowledge, achieving sustained behavioral change requires a multidimensional approach (Alzaben et al., 2024). The results highlight the importance of integrating stress management, environmental support, and policy-level interventions to enhance the effectiveness of lifestyle modification programmes.

CONCLUSION

The present study concludes that the structured Nutrition Education Programme was highly effective in improving lifestyle-related knowledge among industrial workers. Significant improvements were also observed in attitude and practice domains, although to a lesser extent. The intervention demonstrated a strong impact on enhancing awareness and promoting positive perceptions toward healthy behaviors.Despite these improvements, the study found that knowledge and attitude did not significantly predict practice behavior, indicating that behavioral change is influenced by multiple factors beyond awareness alone. Additionally, the strong association between practice and stress highlights the importance of addressing psychological factors in lifestyle interventions.

Overall, the findings confirm that workplace-based nutrition education programmes can play a crucial role in improving health-related behaviors. However, sustained and comprehensive strategies are required to translate knowledge into long-term behavioral change and improved health outcomes.

RECOMMENDATIONS

At the organizational level, industries should implement regular and structured Nutrition Education Programmes to promote awareness and healthy lifestyle practices among employees (Buhlan & Nayak, 2024). These programmes should be conducted periodically to reinforce learning and support sustained behavior change. Workplaces should also establish routine health monitoring systems, including regular screening for body mass index, stress levels, and other health indicators. This will help in early identification of risk factors and enable timely interventions. Additionally, organizations should create a supportive environment by providing access to healthy food options, encouraging physical activity, and promoting stress management practices within the workplace. Mandatory implementation of workplace health programmes, including nutrition education and lifestyle interventions, should be considered to improve the overall health of the working population. Such initiatives can contribute to the prevention of non-communicable diseases and enhance workforce productivity.

CONFLICT OF INTEREST

Nil

ACKNOWLEDGMENT

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

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