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RESEARCH ARTICLE

Food Security, Nutritional Status and Prevalence of Hypertension Among Industrial Migrant Workers in Chennai

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Abstract

Objectives: This study assesses the lifestyle of industrial migrant workers in Chennai, focusing on associations between the food security of migrant workers and hypertension, category of work, their native state, and body mass index. **Methods**: An in-depth analysis of their eating patterns was conducted by using a three-day dietary record and a regional food frequency questionnaire. Anthropometric measurements were acquired, which together with their dietary data assessed their nutritional status. The Food Insecurity Experience Scale was used to evaluate the migrant workers' level of food security, while a digital blood pressure monitor was used to measure the participants' blood pressure. The chi-square test was analyzed to measure the significance of the difference in outcome variables between groups. **Findings**: 41.24% of migrants do not face food security. However, their food diversity has significantly decreased. The BP is high among migrant workers (136.66±19.36/98.54±13.37mmHg) compared to Indian adults, with 84.54% being hypertensive. The results show that the food security of migrant workers was not significantly correlated with hypertension ($p>0.345$), category of work ($p>0.085$), their native state ($p>0.315$), and BMI ($p>0.963$). This suggests that dietary acculturation plays a major role and could potentially result in the rise in comorbidities. **Novelty**: Migrant workers, categorized as vulnerable groups, lack necessary attention. This study provides valuable insight into the lifestyle of migrant workers living in Chennai by utilizing multiple methods. The need for quality and adequate food to enhance the nutritional status is emphasized. For this, it's important to identify migrant workers with comorbidities, educate them, and provide aid to alleviate their situation.

Keywords: Food security; Food Insecurity Experience Scale; Migrant workers; Nutritional status; Hypertension; Malnutrition

1 Introduction

The United Nations Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families defines a migrant worker as a person who is to be engaged is engaged, or has been engaged in a remunerated activity in a state of which he or she is not a citizen. For the period of July 2020 to June 2021, the migration rate throughout all of India was 28.9%, with a migration rate of 26.5% in rural regions and 34.9% in urban regions. A greater migration rate of 47.9% was seen among females, with 48% of them migrating to rural regions and 47.8% to urban areas. 86.8% of women moved for marriage, while 49.6% of men moved in pursuit of work. Male migration rates were 10.7%, with rural regions accounting for 5.9% and urban areas for 22.5%[1]. Industrial migrant workers who migrate in pursuit of work are generally unskilled or semi-skilled workers belonging to the lower socio-economic class. These workers become susceptible because they typically labor in 3-D jobs (dirty, dangerous, and demanding jobs). In most cases, the migrant workers come alone to the new city, leaving their families behind. Hence, they are considered to be seasonal workers who work for a few months in another state and return to their hometown to be with their family.

The major states from which laborers migrate are Uttar Pradesh, Bihar, Madhya Pradesh, and Rajasthan. The major states to which they migrate are Delhi, Kerala, Maharashtra, Gujarat, and Tamil Nadu. Some individuals migrate to join families, pursue education, find employment, or have better economic prospects. Others relocate in order to flee hostilities, persecution, terrorism, or human rights breaches, and even in reaction to the unfavorable consequences of environmental variables like natural catastrophes or climate change. Though they come seeking better opportunities to improve their livelihood, the process is not easy. The reason is that industrial migrant workers, especially low-skilled, labor-intensive workers, face lots of issues and injustices consisting of wage-related abuse, unpaid overtime work, a lack of social security coverage, and a lack of security during enlistment and employment[2].

Adding to this, a substantial effect of the COVID-19 epidemic was witnessed in migrant laborers throughout India, particularly those in Tamil Nadu. Many encountered difficulties during the lockdowns. Some were trapped without employment, while others faced travel restrictions. Relief efforts were offered by the government and NGOs to help them during this time. A number of laws protect the migrant workforce of the nation. Despite this, the workers faced several difficulties since these laws are more accessible to the organized sector than to the unorganized and informal sectors. Due to a lack of information and their not being registered as migrants of that state, they were unable to access the beneficial schemes and policies during COVID-19[3,4].

When people migrate, they lose access to the food security that they once had in their hometown. The main factor leading to food insecurity is the unfamiliar feeling and the lack of awareness that comes with a new place. The dietary diversity after migration significantly reduces and has to be explored in detail. They may also adopt unhealthy behaviors to cope with separation from their family[5]. The risk of hypertension was greater in those who drank alcohol almost daily, once a week, or even less occasionally than once a week than in those who did not[6]. People who do not have formal medical training are known as informal healthcare providers. It was noted that 66% of people from slums and 9% from the middle class seek care from these informal healthcare providers[7]. They find it challenging to obtain healthcare when necessary due to a lack of understanding of the health insurance systems and language obstacles[5,8,9]. Hence, the incidence of hypertension is now concentrated among the impoverished. The dangerous working circumstances and mounting societal demands to survive, which are to blame for lifestyle modifications like consumption of calorie-dense foods and excessive amounts of alcohol, should be addressed by policy[6]. People migrate to improve their quality of life. Yet the migration process itself worsens food security. This is known as the migration-food security nexus[9]. Food security, as defined by the United Nations Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. According to this widely accepted definition, food security is comprised of four components: food availability, food access, utilization, and stability[10].

Dietary change is one of the major barriers faced by migration. These barriers result in an increase in the prevalence of non-communicable diseases like hypertension, diabetes, cardiovascular disease, and so on. A considerable financial burden is connected to hypertension. The cost of living for migratory workers who move to a new location in order to earn more money is increased by hospitalizations for BP-related complications and disability, from hypertension-related cardiovascular and renal disorders, as well as direct healthcare costs associated with managing blood pressure, such as medication, laboratory tests, and clinic visits, which are all included in the costs[11]. Hence, it's important to identify migrant workers with hypertension, educate them, and provide aid to alleviate their situation[12]. This education involves making them aware of the health benefits available to them through the different policies, health care centers around their vicinity, sanitation practices, self-care, or personal hygiene, and how to make use of the resources available to them. In the long run, by utilizing the different policies, food security can be achieved and the nutritional status of the migrant workers can be improved, which will lead to a reduction in the incidence and prevalence of non-communicable diseases. Considering this, the present study focuses on the association

of food security of migrant workers with hypertension, category of work, their native state, and body mass index.

2 Methodology

The present study employed a convenient sampling technique for efficient and quicker data collection from the migrant population. Using this approach, the industries and participants for the study were selected based on convenience proximity, and accessibility. Participants were industrial male and female migrant workers of 18-40 years of age who gave consent to participate in the study. Migrant workers who have settled in Chennai with their families for 2 years or more were not included in the study. Under observational study design, a cross-sectional study design was adopted, which evaluated the degree of association between an exposure and a disease variable without taking any action [13]. A sample size of 96 was determined based on the population of migrant workers in Chennai. The study was approved by the Institutional Ethics Committee of Sri Ramachandra Institute of Higher Education and Research, Chennai, India (IEC- CSP/23/JUL/132/619).

2.1 Tools and techniques used for data collection

2.1.1 Questionnaire

Demographic data on the participants was collected. The characteristics that were included in this study are name, age, date of birth, gender, menstruation, education, occupation, duration of current occupation, native state, and mother tongue.

2.1.2 Height

The participants' line of sight was parallel to the floor, and they were staring straight ahead. The participants were standing with their heels, buttocks, heads, and shoulders touching a level surface (the wall). Any footwear, oversized garments, hair accessories, and unbraided hair that could obstruct the measurement were removed. Height, precisely to the nearest 1/8-inch or 0.1 centimeter, was noted.

2.1.3 Weight

A digital electronic scale was used to measure the weight of participants to the nearest 0.1 kilogram. Shoes and any heavy clothing had been requested to be removed before standing on the scale.

2.1.4 Body mass index

The body mass index (BMI) of the participants was determined using their height and weight. BMI is equal to weight (kg)/height (m^2). The determined BMI was then interpreted using the Asian-Pacific guidelines [14].

Interpretation	Asian-Pacific (BMI)
Underweight	<18.5 kg/m^2
Normal	18.5-22.9 kg/m^2
Overweight	23-24.9 kg/m^2
Obese I	25-29.9 kg/m^2
Obese II	≥30 kg/m^2

2.1.5 Waist and hip circumference

The circumference of the waist and hips of participants was measured when they were standing straight and not tucking in their stomachs. An inelastic and flexible measuring tape was used, with measurements taken to the nearest 0.1 cm. Hip circumference was taken at the maximum circumference around the buttocks, and waist circumference was measured midway between the iliac crest and lower ribs (just above the navel).

2.1.6 Waist-to-hip ratio

The waist-to-hip ratio was determined by dividing the waist circumference by the hip circumference. Numerous studies have linked waist-to-hip ratio to blood pressure levels and/or systemic hypertension. The World Health Organization has suggested that people with waist-to-hip ratio cutoffs of > 0.90 for males and ≥ 0.85 for females can be identified as having an elevated risk of metabolic problems [15].

2.1.7 Mid-upper arm circumference

The mid-upper arm circumference, or MUAC, is employed in underdeveloped nations for quick and comprehensive nutrition surveillance and screening programs since it is a simple and affordable method of determining nutritional status.

MUAC is the circumference of the non-dominant upper arm. It is measured at the midpoint between the olecranon process and the acromion process, or, in other words, between the tip of the elbow and the shoulder.

In hospitalized individuals, MUAC is a helpful malnutrition indication. The normal MUAC range is >23 cm in males and >22 cm in females (Yallamraju, S. R., et al., 2014).

2.1.8 Three-day dietary record

The participants were asked to note down what they ate for three days (two weekdays and one weekend). The quantity of meals eaten was determined by the use of measuring cups and spoons and weighing food items of different quantities. 300g, 500g, and 750g of rice, 50g of chapathi, and 50g of poriyal were shown to get accurate amounts of food consumed.

2.1.9 Food Frequency Questionnaire

Food was categorized into 13 groups, and the frequency of consumption of the food items listed under each food group was recorded. Based on the score obtained from their answer, the participants were categorized as having 'good, moderate, or poor' consumption of that particular food group in terms of quality and quantity. The 13 food groups are: Cereal Grains and Products, Pulses and Legumes, Green leafy vegetables, Roots and Tubers, Other vegetables, Fruits, Milk and milk products, Meat and Poultry and Fish, Nuts and Oilseeds, Sugars, Fats and Edible Oils, Condiments and Spices, Snacks and Beverages.

2.1.10 FIES Tool

The Food Insecurity Experience Scale (FIES) was used to measure food security. FIES is the measure of the intensity of food insecurity based on experience. The FIES is a statistical tool used to assess intangible characteristics like aptitude/intelligence, personality traits, and a variety of social psychology and related health problems. It is dependent on participants' subjective answers to questions concerning their personal encounters with limited food availability. It is simple to incorporate the FIES Survey Module (FIES-SM), which consists of eight questions about people's access to enough food, into various types of demographic surveys[(16)].

2.1.11 Blood pressure

A digital blood pressure monitor was used to measure the blood pressure of the participants. The participants were asked to rest for at least 5 minutes. The cuff was kept around the left wrist, the arm at heart level, and the reading was recorded. The collected data was interpreted in accordance with the International Society of Hypertension, 2020[(17)].

Category	Systolic (mmHg)		Diastolic (mmHg)
Normal	<130	and/or	<85
High normal	130-139	and/or	85-89
Grade 1 hypertension	140-159	and/or	90-99
Grade 2 hypertension	≥160-179	and/or	≥100

2.2 Statistical Analysis

Following the data collection, the data obtained was sorted and then subjected to statistical analysis.

SPSS software trial version 21 was used to analyze data entered into an MS Excel sheet. Means and standard deviations were utilized to represent quantitative data, while percentages were applied to qualitative data. The chi-square test was analyzed to measure the significance of the difference in outcome variables between groups. A p-value of 0.05 was regarded as statistically significant.

3 Results and Discussion

3.1 Results

3.1.1 Anthropometric profile of the study population

It was observed that the mean height and weight of the participants were observed to be 159.48 ± 6.95cm and 53.12 ± 8.25 kg, respectively. The BMI interpretation was made in accordance with Asian Pacific guidelines. Among the participants, the majority fall under the 'normal' category (61.86%), 20 fall under the 'underweight' category (20.62%), 11 fall under the 'overweight' category (11.34%), 4 fall under the 'Obese I' category (4.12%), and 2 fall under the 'obese II' category (2.06%). The mean BMI (20.88 ± 2.97 kg/m^2) of the participants falls under the 'normal' category (Table 1).

Waist-to-hip ratio interpretation was made in accordance with WHO. It was observed that, among the participants, the majority (79.38%) fall under the 'normal' category, while 20.62% fall under the 'risk' category. The mean waist circumference and hip circumference of the participants were observed to be 74.97 ± 7.98 cm and 86.43 ± 7.55 cm respectively, while the mean waist-to-hip ratio of the participants was observed to be 0.87 ± 0.05. From MUAC, it was observed that the majority of the participants (97.94%) fall under the 'normal' category, while 2.06% fall under the 'wasting' category. The mean mid-upper arm circumference was observed to be 26.93 ± 2.63 cm (Table 1).

Table 1. Anthropometric profile of the study population

Parameter	Mean ± SD	Interpretation	Number	Percentage (%)
Height (cm)	159.48 ± 6.95			
Weight (kg)	53.12 ± 8.25			
BMI (kg/m^2)	20.88 ± 2.97	Normal 18.5-22.9 kg/m^2	60	61.86
		Obese II ≥30 kg/m^2	2	2.06
		Overweight 23-24.9 kg/m^2	11	11.34
		Obese I 25-29.9 kg/m^2	4	4.12
		Underweight <18.5 kg/m^2	20	20.62
		Total	97	100
Waist Circumference (cm)	74.97 ± 7.98			
Hip Circumference (cm)	86.43 ± 7.55			
Waist to Hip ratio	0.87 ± 0.05	Normal	77	79.38
		Risk	20	20.62
		Total	97	100
Mid upper arm circumference (cm)	2.63	Normal	95	97.94
		Wasting	2	2.06
		Total	97	100

3.1.2 Frequency and percentage of Levels of Food Insecurity in the study population

It was observed that, out of 97 participants, 41.24% of migrants do not face food security. Whereas 28.87% face mild food insecurity, 20.62% face moderate food insecurity and 9.28% face severe food insecurity (Table 2).

Table 2. Frequency and percentage of Levels of Food Insecurity in the study population

Levels Of Food Insecurity	Number	Percentage (%)
Mild	28	28.87
Moderate	20	20.62
No Food insecurity	40	41.24
Severe	9	9.28
Total	97	100

3.1.3 Frequency and percentage of food frequency questionnaire in the study population

It was observed that the frequency of consumption of cereal grains and products was good in 74.23% and moderate in 25.77%. The frequency of consumption of pulses and legumes was good in 74.23% and moderate in 25.77%. The frequency of consumption of green leafy vegetables was good in 13.40%, moderate in 12.37%, and poor in 74.23%. The frequency of consumption of roots and tubers was good in 75.26% and moderate in 24.74%. The frequency of consumption of other vegetables was good in 75.26%, moderate in 22.68%, and poor in 2.06%. The frequency of consumption of fruits was good in 7.22%, moderate in 8.25%, and poor in 84.54%. The frequency of consumption of milk and milk products was good in 25.77%, moderate in 55.67%, and poor in 18.56%. The frequency of consumption of meat, poultry, and fish was good in 24.74%, moderate in 43.30%, and poor in 31.96%. The frequency of consumption of nuts and oilseeds was good in 7.22%, moderate in 19.59%, and poor in 73.20%. The frequency of consumption of sugar was good in 26.80%, moderate in 54.64%, and poor in 18.56%. The frequency of consumption of fats and edible oils was good for all migrant workers (100%). The frequency of consumption of condiments and spices was good for all migrant workers (100%). The frequency of consumption of quality snacks and beverages was good in 1.03% and poor in 98.97% (Table 3).

Table 3. Frequency and percentage of food frequency questionnaire in the study population

Cereal Grains And Products	**Number**	**Percentage (%)**
Good	72	74.23
Moderate	25	25.77
Pulses And Legumes	**Number**	**Percentage (%)**
Good	72	74.23
Moderate	25	25.77
Green Leafy Vegetables	**Number**	**Percentage (%)**
Good	13	13.40
Moderate	12	12.37
Poor	72	74.23
Roots And Tubers	**Number**	**Percentage (%)**
Good	73	75.26
Moderate	24	24.74
Other Vegetables	**Number**	**Percentage (%)**
Good	73	75.26
Moderate	22	22.68
Poor	2	2.06
Fruits	**Number**	**Percentage (%)**
Good	7	7.22
Moderate	8	8.25
Poor	82	84.54
Milk And Milk Products	**Number**	**Percentage (%)**
Good	25	25.77
Moderate	54	55.67
Poor	18	18.56
Meat, Poultry, Fish	**Number**	**Percentage (%)**
Good	24	24.74
Moderate	42	43.30
Poor	31	31.96
Nuts And Oilseeds	**Number**	**Percentage (%)**
Good	7	7.22
Moderate	19	19.59
Poor	71	73.20
Sugars	**Number**	**Percentage (%)**
Good	26	26.80
Moderate	53	54.64
Poor	18	18.56
Fats And Edible Oils	**Number**	**Percentage (%)**
Good	97	100.00
Condiments And Spices	**Number**	**Percentage (%)**
Good	97	100.00
Snacks And Beverages	**Number**	**Percentage (%)**

Continued on next page

Table 3 continued

Good	1	1.03
Poor	96	98.97

3.1.4 Macronutrient intake of the study population

It was observed that the mean energy requirement among the participants was 2445.19 ± 805.64 kcal, the intake was 1764.61 ± 488.06 kcal, and the %met was 80.2 ± 33.3 %. The mean protein requirement among the participants was 46.12 ± 6.21 g, the intake was 48.68 ± 13.68 g, and the %met was 106.82 ± 30.42%. The mean fat requirement among the participants was 67.89 ± 22.35 g, the intake was 28.11 ± 12.32 g, and the %met was 50.07 ± 33.82 %. The mean carbohydrate requirement among the participants was 363.59 ± 118.37 g, the intake was 330.04 ± 109.15 g, and the %met was 99.27 ± 41.12% (Table 4).

Table 4. Macronutrients of the study population

Parameter	Requirement	Intake	%Met
Energy (kcal)	2445.19 ± 805.64	1764.61 ± 488.06	80.2 ± 33.3
Protein (g)	46.12 ± 6.21	48.68 ± 13.68	106.82 ± 30.42
Fat (g)	67.89 ± 22.35	28.11 ± 12.32	50.07 ± 33.82
Carbohydrate (g)	363.59 ± 118.37	330.04 ± 109.15	99.27 ± 41.12

3.1.5 Hypertension of the study population

From the table above, it was observed that, out of 97 participants, the mean systolic blood pressure was observed to be 136.66 ± 19.36 mmHg, and the mean diastolic blood pressure was observed to be 98.54 ± 13.37 mmHg. From the table above, it was observed that, among the participants, the majority (51.55%) fall under 'Grade 2 hypertension', 26.80% fall under 'Grade 1 hypertension', 15.46% fall under 'Normal', and 6.19% fall under 'High Normal'. Prevalence of 84.54% was observed in this study (Table 5).

Table 5. Hypertension of the study population

Parameter	Mean ± SD	
Systolic (mmHg)	136.66 ± 19.36	
Diastolic (mmHg)	98.54 ± 13.37	
Interpretation	**Number**	**Percentage**
Grade 1 hypertension	26	26.80%
Grade 2 hypertension	50	51.55%
High Normal	6	6.19%
Normal	15	15.46%
Total	97	100

3.1.6 Comparative analysis of Levels of Food Insecurity and hypertension in the study population

Different levels of food insecurity are being compared with different grades of hypertension. The p-value obtained is 0.345, which is greater than 0.05. It is not statistically significant. This means that there is no significant relationship between food security and hypertension, and the null hypothesis is accepted. Of the 26 participants who come under 'Grade 1 hypertension', 38.5% have mild food insecurity, 26.9% have moderate food insecurity, 3.8% have severe food insecurity, and 30.8% do not experience food insecurity. Of the 50 participants who come under 'Grade 2 hypertension', 24% have mild food insecurity, 18% have moderate food insecurity, 10% have severe food insecurity, and 48% do not experience food insecurity. Of the 6 participants who fall under 'high normal', 16.7% have mild food insecurity, no one has moderate food insecurity, 33.3% have severe food insecurity, and 50% do not experience food insecurity. Of the 15 participants who fall under 'Normal' i.e., do not have hypertension, 33.3% have mild food insecurity, 26.7% have moderate food insecurity, 6.7% have severe food insecurity, and 33.3% do not experience food insecurity (Table 6).

Table 6. Comparative analysis of Levels of Food Insecurity and hypertension in the study population

		Hypertension Interpretation								Total	
		Grade 1 hypertension		Grade 2 hypertension		High Normal		Normal			
		N	%	N	%	N	%	N	%	N	%
Levels of food insecurity	Mild	10	38.5	12	24	1	16.7	5	33.3	28	28.9
	Moderate	7	26.9	9	18	0	0	4	26.7	20	20.6
	No Food insecurities	8	30.8	24	48	3	50	5	33.3	40	41.2
	Severe	1	3.8	5	10	2	33.3	1	6.7	9	9.3
Total		26	100	50	100	6	100	15	100	97	100
P value		0.345									

3.1.7 Comparative analysis of Levels of Food Insecurity and Category of Work in the study population

Different levels of food insecurity with the lifestyles of migrant workers are being compared in this study. The p-value obtained is 0.085, which is greater than 0.05. It is not statistically significant. This means that there is no significant relationship between food security and the category of work, and the null hypothesis is accepted.

Of the 54 participants who are heavy workers, 18.5% have mild food insecurity, 24.1% have moderate food insecurity, 9.3% have severe food insecurity, and 48.1% do not experience food insecurity. Of the 43 participants who are sedentary workers, 41.9% have mild food insecurity, 16.3% have moderate food insecurity, 9.3% have severe food insecurity, and 32.6% do not experience food insecurity (Table 7).

Table 7. Comparative analysis of Levels of Food Insecurity and Category of Work in the study Population

		Category of work				Total	
		Heavy worker		Sedentary worker			
		N	%	N	%	N	%
Levels of food insecurity	Mild	10	18.5	18	41.9	28	28.9
	Moderate	13	24.1	7	16.3	20	20.6
	No Food insecurities	26	48.1	14	32.6	40	41.2
	Severe	5	9.3	4	9.3	9	9.3
Total		54	100	43	100	97	100
P value		0.085					

3.1.8 Comparative analysis of Levels of Food Insecurity and Native in the study population

Different levels of food insecurity are being compared with the native state of migrant workers. The p-value obtained is 0.315, which is greater than 0.05. It is not statistically significant. This means that there is no significant relationship between food security and the native state, and the null hypothesis is accepted.

Of the 10 participants who came from Assam, 30% have mild food insecurity, 10% have moderate food insecurity, 20% have severe food insecurity, and 40% do not experience food insecurity. Of the 7 participants who came from Bihar, 71.4% have mild food insecurity, no one experiences moderate or severe food insecurity, and 28.6% do not experience food insecurity. Of the 54 participants who came from Chhattisgarh, 18.5% have mild food insecurity, 24.1% have moderate food insecurity, 9.3% have severe food insecurity, and 48.1% do not experience food insecurity. Of the 8 participants who came from Jharkhand, 25% have mild food insecurity, 37.5% have moderate food insecurity, 12.5% have severe food insecurity, and 25% do not experience food insecurity. Of the 17 participants who came from Orissa, 47.1% have mild food insecurity, 17.6% have moderate food insecurity, 5.9% have severe food insecurity, and 29.4% do not experience food insecurity. No one from Nagaland experienced food insecurity (Table 8).

Table 8. Comparative analysis of Levels of Food Insecurity and Native in the study population

		Native State												Total	
		Assam		Bihar		Chhattis-garh		Jharkhand		Nagaland		Orissa			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Levels of food insecurity	Mild	3	30	5	71.4	10	18.5	2	25	0	0	8	47.1	28	28.9
	Moderate	1	10	0	0	13	24.1	3	37.5	0	0	3	17.6	20	20.6
	No food insecurities	4	40	2	28.6	26	48.1	2	25	1	100	5	29.4	40	41.2
	Severe	2	20	0	0	5	9.3	1	12.5	0	0	1	5.9	9	9.3
Total		10	100	7	100	54	100	8	100	1	100	17	100	97	100
P value		0.315													

3.1.9 Comparative analysis of Levels of Food Insecurity and BMI in the study population

Different levels of food insecurity are being compared with the BMI of migrant workers. The p-value obtained is 0.963, which is greater than 0.05. It is not statistically significant. This means that there is no significant relationship between food security and BMI, and the null hypothesis is accepted.

Of the 60 participants who fall under the normal BMI category, 30% have mild food insecurity, 20% have moderate food insecurity, 10% have severe food insecurity, and 40% do not experience food insecurity. Of the 2 participants who fall into the obese II category, no one experienced food insecurity. Of the 11 participants who came under the overweight BMI category, 18.2% have mild food insecurity, 18.2% have moderate food insecurity, 9.1% have severe food insecurity, and 54.5% do not experience food insecurity. Of the 4 participants who came under the obese I BMI category, 25% have mild food insecurity, 25% have moderate food insecurity, no one experiences severe food insecurity, and 50% do not experience food insecurity. Of the 20 participants who fall under the underweight BMI category, 35% have mild food insecurity, 25% have moderate food insecurity, 10% have severe food insecurity, and 30% do not experience food insecurity (Table 9).

Table 9. Comparative analysis of Levels of Food Insecurity and BMI in the study population

		BMI Interpretation										Total	
		Normal		Obese II		Overweight		Obese I		Underweight			
		N	%	N	%	N	%	N	%	N	%	N	%
Levels of food insecurity	Mild	18	30	0	0	2	18.2	1	25	7	35	28	28.9
	Moderate	12	20	0	0	2	18.2	1	25	5	25	20	20.6
	No food insecurities	24	40	2	100	6	54.5	2	50	6	30	40	41.2
	Severe	6	10	0	0	1	9.1	0	0	2	10	9	9.3
Total		60	100	2	100	11	100	4	100	20	100	97	100
P value		0.963											

4 Discussion

According to the WHO, globally, 1.28 billion people between the ages of 30 and 79 are predicted to have hypertension; the majority of these people (two-thirds) live in low- and middle-income nations. In this study, participants were from the age group of 18–40 years, and high blood pressure was observed in a majority of them. This shows that even people in their 20s are at risk for hypertension. When people migrate, they lose access to the food security that they once had in their hometown. It was observed that the majority of the migrant workers are at risk and face food insecurity.

Malnutrition, both undernutrition and overnutrition, was observed among the industrial migrant workers. 20.62% of the participants were underweight, yet only 2.06% fell under the 'wasting' category. 17.52% of the participants were overweight and obese in this study, thereby being concordant with a study done by Khatri, M., et al. (2021), where 18.9% of factory workers were obese[18]. Begam, N. S., et al. (2016), in their study, observed that 79.6% of the participants had abdominal obesity and 65.9% of the participants had a BMI >25 kg/m^2. While 20.62% had abdominal obesity here. This could be due to the majority

being engaged in hard and demanding jobs.

In another study conducted in Chennai, 61.64% of migrants claimed they were not able to buy enough food during the pandemic[3]. As many were unaware of the policies of the region they migrated to, they were not able to utilize them. This factor still acts as a major barrier to food security as 58.76% of the migrant workers in this study face mild to severe food insecurity. Their food diversity was drastically reduced upon migration. This was observed when a regional food frequency questionnaire was utilized. Similarly, Khatri, M., et al. (2021) observed low consumption of fruits and vegetables in 100% of factory workers compared to 83% of non-factory workers[18]. Begam, N. S., et al. (2016) also observed that 86.9% of migrant workers had a low intake of fruits and vegetables.

Carney, M. A., Krause, K. C., (2020) in their study, reported that though the workers had access to commodities like rice, oil, eggs, and fresh vegetables, they didn't have access to a kitchen or a proper storage space. This resulted in them buying low-nutrition and high-calorie foods[9]. The food diversity here too got significantly low. Bansal, D., et al. (2010) observed that the proportion of people reporting weekly consumption of Western foods including noodles, bread/toast, chips, soups, ketchup, vegetarian and non-vegetarian puffs, jam, cakes/sweet pastries, ice cream, and biscuits (sweet) was highest in the urban sample, lowest in the rural sample, and intermediate in the migrant sample.

It is quite evident that dietary acculturation could potentially cause an increase in the prevalence of non-communicable diseases. The BP was observed to be high among migrant workers (136.66±19.36 /98.54±13.37mmHg) compared to Indian adults, with 84.54% being hypertensive. This increase could be due to the environment, unawareness, dietary habits, lifestyle choices, and alcoholism. Ramakrishnan, S., et al. (2019) observed that the mean systolic blood pressure was 121.2 ± 15.6 mmHg and the mean diastolic blood pressure was 78.1 ± 10.9 mmHg in the country among the age group of 20–44 years[19]. This shows that both SBP and DBP are high among migrant workers compared to Indian adults. This is in concurrence with the study done by Goyal, P., et al. (2024), which also reported the same[11]. In Barde, P., et al. (2017) study, the overall prevalence of hypertension in the migrant population was 18.44%, contrary to what was observed here. Ramakrishnan, S., et al. (2019) determined the overall prevalence of hypertension in India to be 30.7%. Between the age groups of 20 and 44 years, the prevalence is 22.4%.

Barde, P., et al. (2017) concluded that the prevalence of pre-hypertension in the migrant worker population was higher than the prevalence in the general population of Nashik. He observed that 27% of migrant populations were pre-hypertensive, while 8% had Stage I Hypertension and 1% of the total had Stage II hypertension. With the increase in prevalence and hypertension being a huge burden in many aspects, Ali, NA., et al. (2022) claimed that regular screening for migrant workers is absolutely necessary. This will prevent complications like coronary heart disease and stroke[20].

5 Conclusion

A majority of the migrant workers were able to meet their nutrient requirements but weren't able to consume a variety of foods and had to restrict themselves to only certain types of food. This was due to the food insecurity faced by them (58.76%) upon migration. The consumption of foods rich in calories, simple carbohydrates, fat, and salt increased due to their accessibility. Out of 97 participants, 82 (84.54%) had hypertension. This shows that the risk of developing comorbidities increases with migration.

The study's strengths include providing valuable insight into migrant workers by utilizing multiple methods, determining hypertension prevalence, investigating dietary patterns, and examining food insecurity. This is one of the few studies that focuses on migrant workers in industrial settings in India. Their average macronutrient intake was compared with the requirement, and food frequency and food security were assessed, which gave insight into their nutritional transition and dietary acculturation. Limitations include not assessing government policies concerning nutrition for migrant workers. Future research could involve implementing interventions to address nutritional issues among migrant workers, such as developing targeted programs to improve food security, increase dietary diversity, and provide education on healthy eating habits. Canteens in the factories with quality food at subsidized rates will cover the food security and nutrition status of the workers. Additionally, further research could focus on evaluating the long-term impact of these interventions and exploring other factors that may influence the health and well-being of migrant populations. Camps to provide nutrition education and promote awareness about healthy eating habits could also be beneficial. These camps could also serve as a platform to address any specific concerns or challenges faced by the workers in their work environment. Empowering them with knowledge and resources will contribute to improving their overall health and well-being.

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