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Demographic and Lifestyle Factors Influencing Cardiovascular Health Among Construction Workers: A Cross-Sectional Analysis

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Abstract: This study examined cardiometabolic parameters and their relationships among construction workers with varying smoking status. This study examines construction workers' cardiovascular (CV) health status, the variations among gender, age, and education groups, and the interaction between CV health (CVH) variables and health practices. This cross-sectional study included 210 construction workers (159 non-smokers and 51 smokers). Anthropometric measures, blood pressure, fasting blood sugar, total cholesterol, and physical activity levels were evaluated. Pearson's correlation analysis was performed to evaluate associations between variables. Smokers exhibited higher physical activity levels ($p=0.03$), while pulse pressure was similar between groups. Body mass index had a weak positive connection with diastolic blood pressure ($r=0.147$, $p=0.034$) and pulse pressure ($r=0.137$, $p=0.048$). Systolic blood pressure ($r=0.697$, $p<0.001$) and pulse pressure ($r=0.965$, $p<0.001$) showed strong positive relationships, while physical activity had a modest link with fasting blood sugar ($r=0.145$, $p=0.036$). The study highlights the relationships between cardiometabolic factors and physical activity levels among construction workers, emphasizing the potential impact of lifestyle factors on cardiovascular health in this occupational group. About one-fourth of the construction workers accomplished only four of the seven "ideal" CVH markers. Because of their stressful jobs and unhealthy lifestyles, construction workers have a moderate to high risk of CV disease.

Introduction

The term "cardiovascular disease" (CVD) refers to a range of disorders that sway the blood circulatory system, comprising the heart along with vasculature, having the ability to move along with carry blood, correspondingly. This multifaceted ailment contains inherited along with acquired conditions. *CVD* is the primary source of death in Europe, accounting for around 50% of death rates and 30% of deaths globally (Nichols et al., 2014). Construction workers face unique occupational dangers and physically demanding work conditions that might harm their cardiovascular health. This industry is distinguished by strenuous labor, extended standing or walking, heavy lifting, and exposure to severe temperatures, noise, and air pollutants (Almaskati et al., 2024). These factors, together with the physically demanding nature of construction labor, can raise construction workers' risk of acquiring cardiovascular diseases (CVD). CVDs encompass conditions that affect the heart along with the circulatory system. Atherosclerosis is a primary contributing factor. Chronic diseases (CVDs) might be diagnosed for a very long period (Frąk et al., 2022).

Earlier studies have repeatedly shown that construction workers have a greater incidence of modifiable CVD risk factors than other occupational categories. These risk factors include hypertension, obesity, smoking, sedentary lifestyles, and poor dietary habits. The combination of occupational exposure and

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unhealthy behaviors can synergistically increase this population's CVD burden (Holthuis et al., 2021).

Hypertension, a key risk factor for CVD, is particularly common among construction workers (Yi et al., 2016). The physically demanding nature of their employment, combined with stress, noise exposure, and inconsistent sleep patterns, can all lead to high blood pressure (Kalantary et al., 2015). Furthermore, the high prevalence of obesity in this community is problematic because it is a well-established risk factor for CVD, metabolic diseases, and other chronic ailments (Al-shoaibi et al., 2024).

Furthermore, construction workers frequently encounter obstacles to adopting and sustaining healthy behaviors due to rigorous work schedules, a lack of access to appropriate food options, and limited opportunities for physical activity during work hours. These challenges can perpetuate unhealthy lifestyle patterns, further exacerbating their CVD risk (Domosławska et al., 2023).

Compared to workers in other industries, they have higher risks for poor CVH, which suggests that PA may not be enough to safeguard their CVH. It is worthwhile to investigate the relationships between CVH factors and healthy behaviors to identify health habits aside from PA that may assist in lowering the risks of CVDs in this population (Tin et al., 2016)

To address these concerns, the American Heart Association (AHA) developed the concept of cardiovascular health (CVH), which includes seven metrics: smoking status, body mass index, physical activity, diet, total cholesterol, blood pressure, and fasting blood glucose (Erin Michos et al., 2022). This strategy evaluates and promotes optimal cardiovascular health by targeting both health habits and biological factors. Assessing CVH scores and associated factors can provide useful information about construction workers' cardiovascular health and inform targeted treatments to reduce their CVD risk.

Given the unique occupational exposures and lifestyle challenges construction workers face, assessing their CVH status and identifying modifiable risk factors is imperative. This study intends to thoroughly evaluate cardiovascular health in this specific group by matching it with the American Heart Association's CVH measures, which include both health behaviors and biological characteristics. This information can be used to establish personalized interventions and preventive strategies to improve construction workers' overall cardiovascular health and well-being, thereby lowering the CVD burden in this high-risk occupational group.

Materials and Methods

This cross-sectional study was carried out in 10 construction sites in and around Chennai. This study was comprised of participants who were willing to participate during the six months from December 2023 to May 2024. The procedure was explained thoroughly to the participants, and informed consent was obtained from them. The inclusion and exclusion criteria for participant selection are given below:

Inclusion criteria:

1. Participants willing to participate
2. Working for 4-8 hours per day
3. Having more than 5 years of work experience.

Exclusion criteria :

1. Participants with respiratory illness,
2. Clinical abnormalities of the vertebral column
3. Recent abdominal surgery or myocardial infarction.

Sample size and sample technique

This cross-sectional study randomly sampled 210 construction site workers to analyze the association between demographic factors and cardiovascular health (CVH) scores over six months.

Assessment

The subject was given a questionnaire that included demographic information such as age (18-30, 31-40, 41-50, 51-60), education (primary/no formal schooling, junior secondary, senior secondary, and post-secondary), smoking status, and physical activity levels. Research assistants measured the workers' height and weight on-site. The body mass index (BMI) was computed using the kg/m2 formula. Participants were classified as underweight (BMI < 18 kg/m^2), normal weight (BMI = 18-22.9 kg/m^2), or overweight (BMI > 23 kg/m^2). Weight was measured with a weighing scale, and height was measured with a wall-mounted tape. Blood pressure was measured with a sphygmomanometer and divided into intermediate and ideal categories (≥120 mm Hg/≥80 mm Hg). Blood samples were collected with the help of a phlebotomist to assess total cholesterol and blood glucose levels (Chung et al., 2018).

Statistical analysis

The data was summarized using descriptive statistics, and the normality of parametric tests was evaluated using the Shapiro-Wilk test. Cardio-metabolic characteristics were compared between groups using an independent t-test. The Pearson's correlation test was used to investigate the associations between the continuous variables. A p-value of

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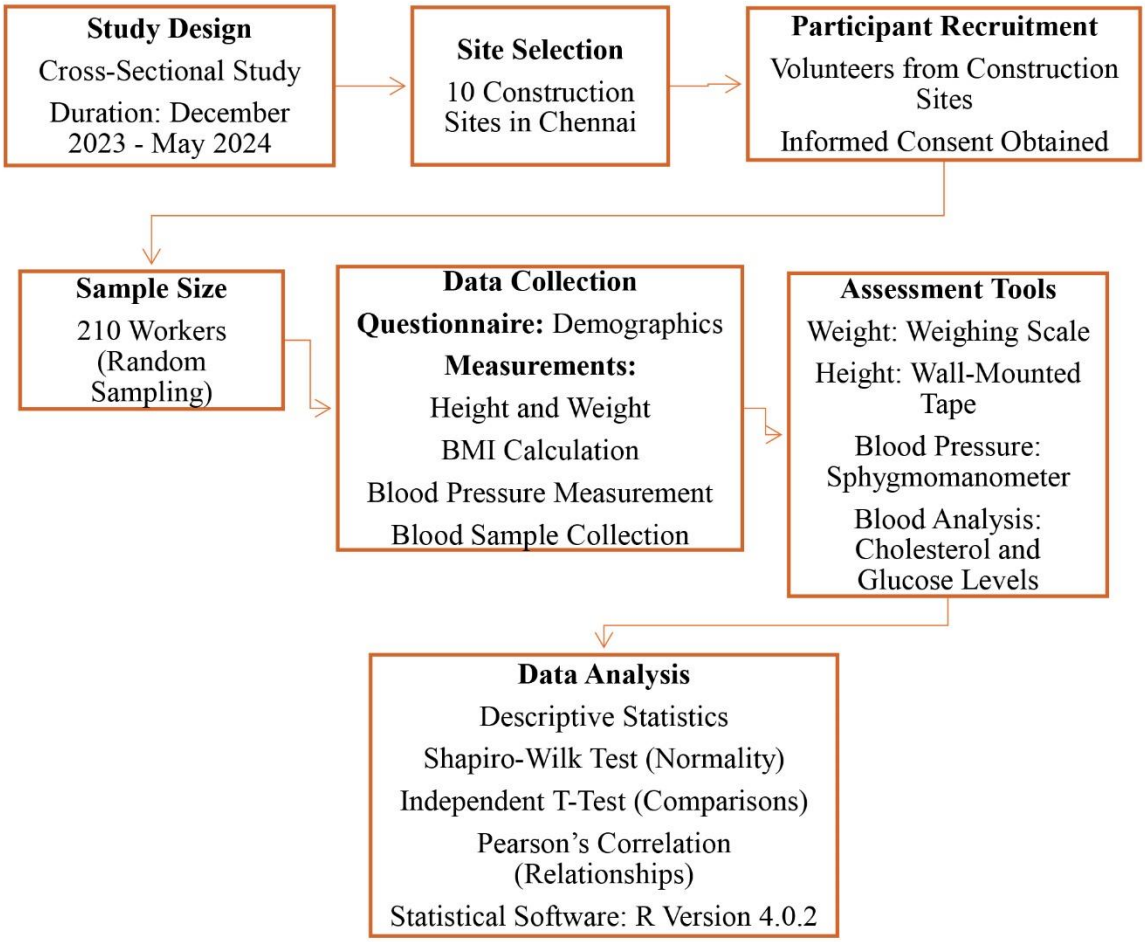

Figure 1. Graphical representation of the methodological Procedure.

<0.05 indicates statistical significance. The statistical analysis was carried out using R version 4.0.2.

Ethical Considerations

The research was carried out with the approval of the Institutional Review Board. Before data collection began, each participant was told of the study's aims, procedures, risks and benefits and written informed consent was obtained from them. It was an open participation in which the participant had the option to withdraw from the study at any moment without penalty. The participants' identities were also not revealed, and all the collected data were stored under lock and key to be accessed only by the researchers. To ensure the anonymity and confidentiality of the participants, the study complied with the laws of data protection. IHEC approval was obtained before starting the research work Ref. No. 002/SBMCH/IHEC/2023/1903.

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Results

Among the construction workers assessed for cardiometabolic changes, the overall mean age was 46.86 years, with no significant difference between non-smokers (46.90 years) and smokers (46.73 years). A notable distinction (Table: 1) was observed in gender distribution, as all smokers were male (100%), whereas 48% of non-smokers were female. Educational levels were comparable across the groups. Although the average pulse pressure (PP) did not differ significantly between non-smokers (94.28 mmHg) and smokers (93.06 mmHg), smokers had a higher level of physical activity (PA) (mean 2.32) than non-smokers (mean 1.99), with a p-

value of 0.03, indicating a significant difference. Other cardiometabolic indicators, such as BMI, blood pressure, fasting blood sugar, and total cholesterol, showed no significant difference between the smoking groups.

with DBP (r=0.69, p<0.001) and PP (r=0.96, p<0.001), consistent with their mathematical relationships. Interestingly, physical activity (PA) showed a weak positive connection with fasting blood sugar (FBS)

Table 1. Cardio-metabolic variables between the constructive workers.

Characteristic	Overall, N = 210	NON SMOKER, N = 159	SMOKER, N = 51	p-value
Age	46.86 (12.08)	46.90 (12.33)	46.73 (11.39)	0.8
Gender				<0.001
Female	76 / 210 (36%)	76 / 159 (48%)	0 / 51 (0%)	
Male	134 / 210 (64%)	83 / 159 (52%)	51 / 51 (100%)	
Education				0.7
Degree	12 / 210 (5.7%)	8 / 159 (5.0%)	4 / 51 (7.8%)	
HSC	167 / 210 (80%)	127 / 159 (80%)	40 / 51 (78%)	
No formal education	31 / 210 (15%)	24 / 159 (15%)	7 / 51 (14%)	
BMI (Body mass index)	23.30 (2.75)	23.45 (2.64)	22.82 (3.06)	0.2
SBP (Systolic blood pressure)	121.80 (22.30)	122.03 (22.48)	121.10 (21.93)	0.9
DBP (Diastolic blood pressure)	82.18 (11.45)	82.25 (11.03)	81.96 (12.79)	>0.9
PP(Pulse pressure)	93.98 (31.37)	94.28 (31.00)	93.06 (32.81)	0.8
PA (Physical Activity)	1.99 (1.45)	1.99 (1.82)	2.32 (1.81)	0.03
FBS (Fasting blood sugar)	110.59 (45.30)	108.33 (45.44)	117.63 (44.57)	0.2
TC (Total Cholesterol)	108.28 (33.87)	108.92 (35.18)	106.31 (29.73)	0.8

The correlation analysis indicated a few significant connections between the variables (Table 2 and Figure 1). Body mass index (BMI) had a weak positive connection with diastolic blood pressure (DBP) (r=0.14, p=0.03) and pulse pressure (PP) (r=0.13, p=0.04). Systolic blood pressure (SBP) showed a significant positive connection

(r=0.14, p=0.036), indicating that exercise may have an effect on glucose levels. Age, however, did not demonstrate significant correlations with any of the cardiometabolic parameters assessed in this study population.

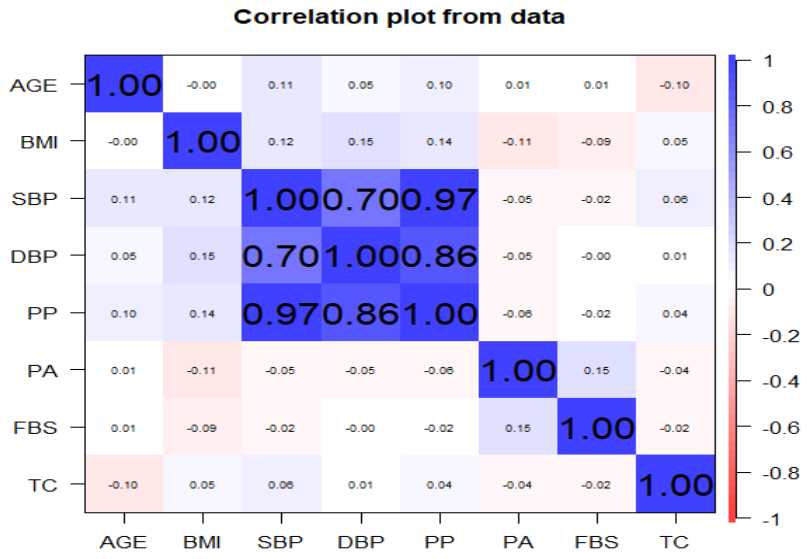

Figure 2. Correlation matrix for the association.

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Table 2. Correlation Matrixes.

		AGE	BMI	SBP	DBP	PP	PA	FBS	TC
AGE	Pearson's r	—							
	Df	—							
	p-value	—							
BMI	Pearson's r	-0.001	—						
	Df	208	—						
	p-value	0.985	—						
SBP	Pearson's r	0.11	0.117	—					
	Df	208	208	—					
	p-value	0.112	0.09	—					
DBP	Pearson's r	0.049	0.147	0.697	—				
	Df	208	208	208	—				
	p-value	0.477	0.034	<.001	—				
PP	Pearson's r	0.096	0.137	0.965	0.86	—			
	Df	208	208	208	208	—			
	p-value	0.165	0.048	<.001	<.001	—			
PA	Pearson's r	0.007	-0.108	-0.053	-0.054	-0.057	—		
	Df	208	208	208	208	208	—		
	p-value	0.921	0.12	0.449	0.434	0.41	—		
FBS	Pearson's r	0.012	-0.091	-0.021	-0.001	-0.015	0.145	—	
	Df	208	208	208	208	208	208	—	
	p-value	0.859	0.189	0.761	0.99	0.826	0.036	—	
TC	Pearson's r	-0.1	0.054	0.059	0.005	0.044	-0.044	-0.023	—
	Df	205	205	205	205	205	205	205	—
	p-value	0.152	0.444	0.398	0.941	0.531	0.526	0.74	—

Discussion

Our study's findings on cardiometabolic parameters among construction workers contribute to a growing body of evidence on cardiovascular health in occupational settings. The occurrence of cardiovascular disease risk factors in our cohort aligns with previous research in similar populations.

A cross-sectional study by Parashar et al. (2017) on male construction workers in Delhi found that all subjects had at least one CVD risk factor, with 93.6% having two or more. This high occurrence of multiple risk factors, particularly among lower-income and unskilled workers, underscores the vulnerability of this population and resonates with our findings on the complex interplay of socioeconomic and occupational factors in cardiovascular health (Parashar et al., 2017).

The danger of CVDs among construction workers was better understood after CVH was quantified (Census and Statistics Department Labour Force, Viester L et al. 2018)

The association between occupational physical activity (OPA) and blood pressure, which was discovered in our study, is further explained by (2023). In their large-scale research of Swedish construction workers, higher OPA was associated with higher systolic and lower diastolic blood pressure, while the differences were minor. This nuanced relationship between OPA and blood pressure metrics aligns with our observations and highlights the need for a comprehensive assessment of physical activity in occupational health studies (Öhlin et al., 2023).

According to recent research (2016), smoking was linked to a reduced BMI, presumably as a result of metabolic effects (Yi et al.2016). Nonetheless, a detailed analysis indicated that heavy smokers, like light smokers, were likely to have a higher BMI than non-smokers, maybe due to their proclivity to develop additional harmful habits (Chiolero et al., 2016). Chung et al. (2018) investigated cardiovascular health among Hong Kong construction workers and discovered that the majority met only three of seven optimal health indicators. Their finding that fish and seafood intake is associated with lower weight and cholesterol levels indicates new dietary interventions that could be applicable to our population, given the link we discovered between physical activity and fasting blood sugar levels (Chung et al., 2018).

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Our findings echo those of a study in Eastern Nepal industrial workers, which reported a 13.8% prevalence of CVD and identified risk factors including age over 45, smoking, family history of hypertension, lack of fruit consumption, and high LDL levels (Khanal MK et al. 2018). Both studies' lack of health education and awareness emphasizes the need for targeted interventions in industrial and construction settings.

The importance of workplace health programs is underscored by Hughes (2024), who highlights that workplaces offer a significant opportunity to promote cardiovascular health despite the current low implementation of comprehensive programs (Hughes et al. 2024). This aligns with our recommendation for tailored health interventions that consider the unique characteristics and behaviors of the construction workforce.

The observation of higher physical activity levels in smokers than in non-smokers gives rise to more questions as to the impact of physical activity, smoking, and cardiovascular risk. It may help in delivering health messages and interventions to counter the health risks associated with smoking and promote physical activity.

Confounding Factors and Study Limitations

Several factors could have biased our study, such as the cross-sectional design, which is also a limitation because it is not possible to determine causality. After all, the data is collected at a single point in time and not longitudinally. Moreover, this study did not assess other covariates such as diet, stress, and genetics that might have other explanations for cardiometabolic health. The self-reported data for physical activity and smoking status may also have a reporting bias. People may over or under-report their smoking status or physical activity levels and this may skew the results of the study. However, BMI as an index of body fatness does not appear to capture differences in cardiovascular risk related to body composition.

Recommendations for Future Research

It is, therefore, advisable for future research to undertake prospective studies in a bid to determine the causal relationship between occupational physical activity and cardiometabolic health. Other more objective measurements, such as accelerometers, could yield more accurate results. In addition, dietary assessment and stress evaluation should also be incorporated to get additional information regarding the patients' cardiovascular risk factors.

Practical Applications and Policy Implications

The study recommends focused health promotion efforts in the construction industry. Employers and policymakers should promote and fund the development of efficient workplace wellness programs that address the health concerns of construction workers. Such programs could include general check-ups once or twice a year, teaching campaigns on the dangers of cardiovascular diseases, and steps that would help people adopt healthy lifestyles.

Conclusion

The study contributes to the knowledge of the cardiometabolic health of construction workers by identifying complex associations between smoking, physical activity, and other health indices. Nonetheless, most research on construction workers' CVH was descriptive (Dias et al., 2023).

This study established that the construction workers' lifestyle and working environment greatly determines their Cardiovascular Health (CVH). The primary preventive approach that involves modifying risk factors includes promoting healthy lifestyle behaviours, including better blood pressure, blood glucose levels, cholesterol levels, and weight status to decrease the risk of CVDs. Although the findings of our study are valuable, much of the previous literature on CVH of construction workers is still largely descriptive in its approach. Subsequent studies should aim to identify the kind of workplace health programs that would be suitable for construction workers, given their risk factors. Such specific measures could prove to be of great importance in improving the global cardiovascular status of this workers category.

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Conflict of interest

I declare that there is no conflict of interest in this study.

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