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Research Article

The Effect of Occupational Isometric Handgrip Exercise on the Blood Pressure of Fuel Attendants in Delta State

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Abstract

Background: Occupational type and job demands have been found to impact cardiovascular health. Aim: This study was designed to evaluate the cardiovascular effect of occupational isometric handgrip exercise on fuel attendants of petrol stations in Delta State. Materials and Methods: A cross-sectional comparative study of 400 petrol station staff participants including 200 fuel attendants 200 administrative staff as controls was conducted to ascertain the cardiovascular effect of their job type. Data was collected using a structured interviewer-administered questionnaire and direct measurements. Systolic, diastolic blood pressures, pulse rate and anthropometric indices were measured. Data were analyzed in SPSS v21 using independent t-tests, ANOVA, and chi-square tests; significance was set at $p < 0.05$. Results: Administrative staff had higher mean systolic BP (148.4 ± 13.2 mmHg) and diastolic BP (96.2 ± 9.1 mmHg) compared to Fuel attendants (122.8 ± 11.8 mmHg and 80.1 ± 7.9 mmHg, $p < 0.001$ respectively). Mean pulse rate was also higher in administrative staff (88.2 ± 8.4 bpm) than fuel attendants (74.6 ± 6.8 bpm, $p < 0.001$). Administrative staff had significantly higher mean BMI (25.8 ± 3.4 kg/m^2) than fuel attendants (23.9 ± 2.8 kg/m^2, $p < 0.001$). Elevated BP prevalence was 31.0% in administrative staff versus 19.0% in fuel attendants ($p = 0.006$), while abnormal pulse rate occurred in 14.0% and 6.0% respectively ($p = 0.008$). Conclusion: Fuel attendants demonstrated comparatively better cardiovascular indices, attributed to the protective effect of the occupational isometric handgrip exercise inherent in their job.

Keywords

Blood Pressure, Fuel Attendants, Administrative Staff, Occupational Exposure, Cardiovascular Health

1. Introduction

The petroleum industry remains a cornerstone of Nigeria's economy, accounting for a substantial portion of national income and employment opportunities [1]. With thousands of fuel stations operating nationwide, staff of petrol stations are continually exposed to a range of occupational hazards that can adversely affect their physiological well-being, particularly their cardiovascular health. The peculiar environment of fuel stations, laden with volatile organic compounds (VOCs),

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high ambient temperatures, prolonged standing, and physical exertion, can impose significant stress on the body, especially the cardiovascular system [2, 3]. Fuel stations represent high-risk environments due to the constant exposure to hazardous substances such as benzene, toluene, ethylbenzene, and xylene (BTEX), which are constituents of gasoline and known to have deleterious health effects [4-6]. Prolonged exposure to these substances has been linked to increased oxidative stress, inflammation, and alterations in autonomic regulation, potentially resulting in elevated blood pressure and altered heart rate [7, 8]. Against this backdrop, this study presents a comparative analysis of blood pressure and pulse rate between fuel attendants and administrative staff of petrol stations in Delta State, Nigeria.

Numerous studies have documented the cardiovascular effects of occupational exposure among petrol station attendants. Singh *et al*., [9] observed elevated systolic and diastolic blood pressure values and increased pulse rates in petrol pump workers compared to healthy control subjects. Similarly, Dissi [10] and [11] Anigilaje et al. [11] reported significant cardiopulmonary dysfunction and increased methaemoglobin levels among fuel attendants in Nigeria. These alterations may arise from the cumulative effects of VOCs inhalation and poor air quality typical of fuel dispensing environments [1, 12].

Delta State is a prominent hub in Nigeria's oil-rich Niger Delta region, and hosts a significant number of filling stations due to its strategic economic role in petroleum distribution. This geographical prevalence makes the occupational health risks faced by fuel attendants in the region particularly noteworthy. Previous research in this locale, such as Moke [13] and Ovuakporaye [14], has highlighted the insufficient use of personal protective equipment and the occurrence of cardiovascular alterations among station workers. These findings underscore the necessity of rigorous, evidence-based assessments of the physiological impacts of prolonged exposure to fuel station environments in Delta State. Moreover, cardiovascular health represented by parameters like blood pressure and pulse rate are critical indices of overall physiological status and constitute leading risk factors for cardiovascular morbidity and mortality globally in the elevated status [15, 16]. Occupational stressors, including those encountered in fuel dispensing activities, can act as significant contributors to hypertension and other cardiovascular abnormalities [17].

Globally, studies have demonstrated the negative impact of prolonged exposure to VOCs on cardiovascular function. For instance, Fedak et al., [18] revealed acute rises in blood pressure following controlled exposures to combustion-related air pollutants. Al-Harbi *et al*., [19] also identified several health symptoms, including cardiovascular irregularities, among fuel station workers in Kuwait. In the African context, Okemuo et al. [20] and Anyiam et al. [21] found hematological and cardiovascular abnormalities among Nigerian petroleum workers, suggesting occupational exposure as a determinant of altered physiological status.

In contrast to fuel attendants, administrative staff in petrol stations generally experience lower levels of physical stress. Their work is primarily cognitive and desk-based, which is often associated with different kinds of stress and cardiovascular risks, such as those from sedentary lifestyles. However, the potential advantage lies in the relatively stable environmental conditions of offices [22]. On the other hand, fuel attendants though exposed to the pollutants, engage in consistent isometric handgrip exercise which has been shown to reduce blood pressure [23]. The early studies of Kiveloff and Huber [24], and Buck and Donner [25] which investigated the effects of isometric exercise on the incidence of hypertension revealed lesser rates of hypertension in persons carrying out occupational or whole-body isometric contractions. These studies were prognostic of the possible ability of isometric exercise training to reduce resting blood pressure and/or lower the occurrence of hypertension. isometric handgrip exercises entail grabbing an object with the strength of the forearms, then keeping it stationary which clearly defines the job of petrol attendants. Isometric research has focused on the ability to utilize isometric handgrip exercise as an intervention in the treatment of hypertension. Wiley et al., [26] conducted isometric hand grip training, which demonstrated 13 mmHg and 15 mmHg reductions in systolic and diastolic pressure, respectively. The participants completed four two-minute contractions separated by three-minute rest periods at 30% MVC, for eight weeks. In a complementary research, participants performed four 45 seconds isometric contractions with one minute rest intervals at 50% MVC, for five weeks. It was found that there were reductions of 9.5 and 8.9 mmHg respectively in systolic and diastolic pressure. In 2000, Ray and Carrasco [27] trained normotensive participants for five weeks. The subjects performed isometric exercise of four three-minute bouts at 30% MVC, with a separation of five-minute rest periods between each contraction. At the end of the five weeks, a reduction of 5 mmHg in diastolic pressure and a 4 mmHg reduction in mean arterial pressure were observed, but no changes in systolic pressure. In another study, hypertensive participants performed isometric handgrip training and had significant reductions in all the cardiovascular parameters with associated decline in sympathetic stimulation but the vagal modulation was increased [28]. This protocol produced reductions of 19 mmHg, 11 mmHg, and 7 mmHg, in systolic, mean arterial, and diastolic blood pressure, respectively. In 2006, Peters et al., [29] recruited ten pre-hypertensive participants in their study and achieved an average reduction of 13 mmHg in systolic pressure following six weeks of isometric hand grip training at 50% MVC. In more recent study, Ogbutor et al., [23] reports a mean reduction of 7.48 ± 0.06 and 6.41 ± 1.01 mmHg of the SBP and DBP, respectively. In their study, a total of 400 prehypertensive subject with a mean age of 40 ± 10 years and recently diagnosed as prehypertension were recruited for the study. They were randomly distributed into exercise and control groups (n = 200). The control group was placed on lifestyle modification only, while the exercise group performed a 24 consecutive day's isometric handgrip exercise training at 30% maximum voluntary contraction (MVC) for 2 min each day in combination with lifestyle modification protocol. More studies have established that isometric handgrip training though simple and cost-effective, has the capacity for improving cardiovascular, respiratory, immune system and inflammatory function [30-33]. This study was therefore designed to evaluate the effect of occupational isometric handgrip exercise on fuel attendants in Delta State.

2. Materials and Methods

2.1. Study Design

This study adopted a cross-sectional comparative design aimed at assessing and comparing blood pressure and pulse rate among fuel attendants and administrative staff of petrol stations in Delta State.

2.2. Materials

The materials used during the study included an automated blood pressure apparatus, a structured interviewer-administered questionnaire, Rapid Assessment of Physical Activity scale or Questionnaire (PAR-Q), weight and height scale. Data collection involved both one-on-one interviews and direct observation. The questionnaire was designed to obtain information on demographic details, educational level, and socioeconomic status, duration of work experience, lifestyle habits, and use of protective equipment such as face masks. Observations were also made regarding work environment conditions for both occupational groups.

2.2.1. Automated Sphygmomanometer

Resting blood pressure and pulse rate were measured using an automated blood pressure monitor (Dinamap Pro 300 Critikon, GE Medical Systems, Slough, Berks, UK and a model number FT-C21Y78). It has a digital LCD display with a blood pressure measurement range of 40 mmHg-280 mmHg and pulse rate of 40-170 b/min with an external dimension of 133 mm X 120 mm X 85 mm with a cuff width of 13×27 cm. The automated device employs the mechanism of oscillometry. The Dinamap Pro 300 Critikon has been validated and conformed to the American National Standards Institute/Association for the Advancement of Medical Instrumentation SP10 1992 requirements for accuracy [34]. It has been reported that the use of an automated monitor device eliminates investigator bias, because readings could be rounded up or down, depending on what the observer expected to measure while using the manual auscultatory method [35]. Any discrepancies in contrast with alternative measurement techniques should not affect the proceeding studies of this study, as long as readings are consistent across the population sample.

2.2.2. Weight and Height Scale

Measurement was done using Digital Weighing Scale (BEU-GS27-007, Beurer GmbH; Ulm, Germany). Digital Weighing Scale (DWSs) has excellent reliability in static limb loading measurement [36]. Height was measured using Stadiometer (Ayron 226, USA); which is a measuring scale for height calibrated in centimeters.

2.3. Study Setting

This study was conducted in petrol stations in Delta State. Delta State lies roughly between longitude 5.00′ and 6.45 East and latitude 5.00 and 6.30 North. The total land area of the state is 7.440sq km and about one third of this is swampy and waterlogged. Delta State is one of the major producers of oil and gas in Nigeria. The state is located in the oil rich Niger Delta region of Nigeria and produces the highest percentage of the country’s total oil and gas which accounts for a significant amount of current foreign exchange earnings. Its reserves accounts for an estimated 40% of the national total of I50 trillion cubic feet of gas. One third of the daily volume of oil comes from the State, which also has some of Nigeria’s major oil -based industries and facilities. These include a refinery, a petrochemical complex, a gas plant, steel complex, two gas-fired electricity stations and an oil export terminus. Delta State is divided into three senatorial districts: Delta North, Delta Central, and Delta South. The state's senatorial districts correspond to different groups of local government areas. This study focused on six selected Local Government Areas (LGAs) that represent both urban and rural populations. The selected LGAs for the study included: Oshimili South LGA - An urban area that includes Asaba, the state capital, with access to modern healthcare facilities. Ndokwa West LGA - A semi-urban region with a mix of commercial and agricultural communities rich in oil and gas exploration. Ughelli North LGA - A major economic hub with both urban and rural settlements, providing a broad population sample. Warri South LGA - A densely populated urban area with significant healthcare infrastructure and industrial activity also rich in oil and gas exploration. Ika North LGA - A rural-urban region with agricultural dominance and moderate healthcare access. Patani LGA- A riverine community with rural settlement.

These LGAs were selected to ensure geographical diversity, socio-economic representation, and variation in healthcare access.

2.4. Sample Size Determination

The sample size was calculated using the Cochran formula for prevalence studies:

$$n = \frac{Z^2.p(1-p)}{d^2}$$

Where:

1) n = required sample size

2) Z = 1.96 (standard normal deviate at 95% confidence level)
3) p = assumed prevalence of hypertension (50% = 0.5 due to absence of local data)
4) d = margin of error (0.05)

$$n = \frac{(1.96)^2.0.5(1-0.5)}{(0.05)^2} = 384$$

A total of 400 participants were recruited to account for non-responses.

2.5. Sampling Technique

A multistage sampling technique was used to ensure a diverse and representative selection of respondents:

Stratified Sampling: Delta State was divided into senatorial districts, and six LGAs were selected to represent different geographical and socio-economic backgrounds. The study population was divided into two strata groups the Fuel attendants and Administrative staff. Within each stratum, participants were randomly selected until the predetermined sample size for each group was achieved. The sample size was calculated to ensure adequate statistical power for comparison between the two groups.

Cluster Sampling: Each LGA was further divided into clusters.

Systematic Random Sampling: petrol stations within the selected clusters were randomly chosen using a sampling interval to ensure fairness.

Purposive Sampling: In petrol stations, fuel attendants and administrative staff were specifically targeted for inclusion. This approach ensured representativeness, reduced bias, and enhanced the generalizability of the study findings.

2.6. Subject Selection

Subjects were selected based on their occupation and length of employment. Study group (Fuel Attendants) included petrol pump attendants working at least 8 hours per day or a minimum of 40 hours per week, for more than 1 year, at various petrol stations within Delta State. Control group (Administrative Staff); included office-based workers with sedentary job roles, matched for age and sex with the study group, recruited from administrative department of the petrol stations in Delta State. All the recruited individuals were sedentary and defined by an average score of three or less using the Rapid Assessment of Physical Activity survey or Questionnaire (PAR-Q).

2.6.1. Inclusion Criteria

1) Fuel attendants and administrative staff of petrol stations in Delta State aged 30-50 years.
2) Duration of employment exceeding one continuous year.
3) Fuel attendants dispensing Premium Motor Spirit (PMS) for more than 8 hours daily or at least 40 hours weekly.
4) Administrative staff of the same petrol stations engaged in indoor, sedentary work for at least 40 hours per week.

2.6.2. Exclusion Criteria

The exclusion of subjects from the study was based on the following criteria:

1) Subjects having queried health status with clinical evidence of the presence of co-morbidities
2) Individuals who were on medical treatment of any form of diseases
3) Individuals who had a recent surgical operation, infection, or vaccination
4) Individuals who had a recent or a previous history of cancer, arthritic diseases or immune disorders
5) Subjects who are athletes and
6) Individuals with acute or chronic traumatization illness or recent injury

2.7. Data Collection: Data Collection Was Carried Out in Two Stages

1) Questionnaire Administration: A pre-tested, interviewer-administered questionnaire was used to gather demographic data, occupational history, lifestyle factors, and use of personal protective equipment.
2) Physiological Measurements: Blood pressure and pulse rate measurements were conducted at the workplace. Resting systolic and diastolic blood pressures and pulse rate were measured using an automated blood pressure device, following the American Heart Association (AHA) guidelines. All measurements were taken in triplicate, and the average value was recorded to improve accuracy.

2.8. Assessment of Subjects and Data Collection

The general and more detail information regarding the participants' health, medication and lifestyles were personally reported by using both a questionnaire and verbal statement during a history taking and medical examination. The succeeding designated health indices were measured to obtain additional information and baseline values of the participants on the relevant indices to this study. The relevant variables were the cardiovascular systems indices and the social demographic data including the height, weight, sex and age.

2.8.1. Biodata

Biodata was collected via face-to-face interview of the participants. The subjects then were formally evaluated exclusively via a structured questionnaire.

2.8.2. Height

This was measured using Stadiometer (Ayron 226, USA); which is a measuring scale for height calibrated in centimeters. The participants each was instructed to stand barefooted on the platform of the height scale with feet together. The knees were flexed at 180o while the participants rested against the height scale with the back with the eyes looking forward. The measure of the height was taken as the space from the scale platform to the vertex of the head which was read and recorded.

2.8.3. Weight

Measurement was done using Digital Weighing Scale (BEU-GS27-007, Beurer GmbH; Ulm, Germany). Each participant was instructed to wear light clothing then stand barefooted, one foot on each side of the scale still standing straightforward on the weighing scale with the arms kept by the side.

2.8.4. Blood Pressure Assessment

The participant's blood pressure was evaluated/measured according to the 2019 American College of Cardiology (ACC)/American Heart Association (AHA) guideline for blood pressure measurement [37], which require subjects to rest in a quiet environment for at least 10 minutes prior to the measurement. The subjects were made to rest in a seated position for at least 15 minutes, comfortably with the back supported, legs uncrossed and upright position in a chair with the arms supported on a table. The cuff was placed around the participant's left arm over the left brachial artery, about 1.5 cm directly above the antecubital fossa and levelled with the heart. Measuring instruction required that the subjects remained silent throughout the procedure. The position adopted by the subjects during measurement was upright position in a chair while the upper limbs were supported on the table, lower limbs uncrossed and feet were positioned flat on the floor. The lowest of three measures was used for analysis, as reported by Wiles et al., [38] (2010), since it has been previously stated that initial measurements are often higher than subsequent measures, and so are not reflective of true resting arterial pressures [39]. Each of the three measures were separated by an interval of 60 seconds, which is in agreement by way of earlier recommendations and studies [38, 40].

2.9. Ethical Clearance

Ethical approval for the study was obtained from the Institutional Ethical Committee of the Faculty of Basic Medical Sciences, Delta State University, Abraka (Approval Code: REC/FBMS/DELSU/25/88). Written informed consent was obtained from all participants before inclusion in the study. Participants were assured of confidentiality, and they retained the right to withdraw at any point without consequences.

2.10. Data Analysis

Data was collected, coded and analyzed on IBM SPSS Statistics Version 21.0. Results were expressed as mean ± standard deviation (SD). Comparative analysis between the two occupational groups was carried out using Independent Samples Student's t-test for normally distributed variables, while One-Way Analysis of Variance (ANOVA) was used for multiple subgroup comparisons. The chi-square test was applied for categorical variables. Statistical significance was set at $p < 0.05$.

3. Results

Table 1. *Socio-Demographic Characteristics of Respondents (N = 400).*

Variable	Fuel Attendants (n = 200)	Administrative Staff (n = 200)	Total (N = 400)
Age Group (years)			
30-40	162 (81.0%)	140 (70.0%)	302 (75.5%)
41-50	38 (19.0%)	60 (30.0%)	98 (24.5%)
Sex			
Male	142 (71.0%)	96 (48.0%)	238 (59.5%)
Female	58 (29.0%)	104 (52.0%)	162 (40.5%)
Marital Status			
Single	82 (41.0%)	68 (34.0%)	150 (37.5%)
Married	102 (51.0%)	112 (56.0%)	214 (53.5%)
Divorced/Widowed	16 (8.0%)	20 (10.0%)	36 (9.0%)
Educational Level			
No Formal Education	16 (8.0%)	0 (0.0%)	16 (4.0%)

Variable	Fuel Attendants (n = 200)	Administrative Staff (n = 200)	Total (N = 400)
Primary Education	42 (21.0%)	6 (3.0%)	48 (12.0%)
Secondary Education	112 (56.0%)	58 (29.0%)	170 (42.5%)
Tertiary Education	30 (15.0%)	136 (68.0%)	166 (41.5%)
Years of Work Experience			
1-5 years	102 (51.0%)	78 (39.0%)	180 (45.0%)
6-10 years	64 (32.0%)	70 (35.0%)	134 (33.5%)
>10 years	34 (17.0%)	52 (26.0%)	86 (21.5%)
Monthly Income (₦)			
< ₦30,000	118 (59.0%)	4 (2.0%)	122 (30.5%)
₦30,000 - ₦60,000	70 (35.0%)	42 (21.0%)	112 (28.0%)
₦61,000 - ₦100,000	8 (4.0%)	86 (43.0%)	94 (23.5%)
> ₦100,000	4 (2.0%)	68 (34.0%)	72 (18.0%)
Work Schedule			
Day Shift Only	84 (42.0%)	190 (95.0%)	274 (68.5%)
Night Shift Only	26 (13.0%)	0 (0.0%)	26 (6.5%)
Rotating Shift	90 (45.0%)	10 (5.0%)	100 (25.0%)
Do you smoke?	Yes	24 (12.0%)	36 (18.0%)
	No	176 (88.0%)	164 (82.0%)
Do you consume alcohol?	Yes	64 (32.0%)	82 (41.0%)
	No	136 (68.0%)	118 (59.0%)
Occupational Physical activity	Daily	52 (26.0%)	48 (24.0%)
	Occasionally	88 (44.0%)	82 (41.0%)
	Rarely	38 (19.0%)	46 (23.0%)
	Never	22 (11.0%)	24 (12.0%)
Diet rating	Balanced	62 (31.0%)	60 (30.0%)
	Moderate	102 (51.0%)	96 (48.0%)
	Unhealthy	36 (18.0%)	44 (22.0%)
Known medical condition	Yes	28 (14.0%)	46 (23.0%)
	No	172 (86.0%)	154 (77.0%)
Variable	Respondent	Fuel Attendants (n = 200)	Administrative Staff (n = 200)
Hours worked/day	<6 hrs	12 (6.0%)	18 (9.0%)
	6-8 hrs	108 (54.0%)	144 (72.0%)
	>8 hrs	80 (40.0%)	38 (19.0%)
Physical stress at work	Yes	160 (80.0%)	126 (63.0%)
	No	40 (20.0%)	74 (37.0%)
Work environment stress	Very stressful	84 (42.0%)	94 (47.0%)
	Moderate	92 (46.0%)	84 (42.0%)
	Not stressful	24 (12.0%)	22 (11.0%)
Exposure to fumes/fuel	Yes	200 (100.0%)	200 (100.0%)

Variable	Fuel Attendants (n = 200)	Administrative Staff (n = 200)	Total (N = 400)
	No	0 (0.0%)	0 (0.0%)
Ever checked BP/pulse rate	Yes	120 (60.0%)	148 (74.0%)
	No	80 (40.0%)	52 (26.0%)

Statistical Interpretation:

The socio-demographic distribution (Table 1) shows that most respondents were aged 30-40 years (75.5%). Males dominated among fuel attendants (71.0%), while females were the majority in administrative roles (52.0%). Educational attainment differed sharply, with 68.0% of administrative staff having tertiary education versus 15.0% of fuel attendants.

Fuel attendants had shorter work experience (51.0% with 1-5 years) and substantially lower income, with 59.0% earning <₦30,000 compared to only 2.0% of administrative staff. Work schedules were also distinct 95.0% of administrative staff worked day shifts only, whereas 45.0% of attendants worked rotating shifts and 13.0%-night shifts.

Lifestyle factors revealed higher smoking (18.0% vs 12.0%) and alcohol use (41.0% vs 32.0%) among administrative staff. Physical activity was similar between groups, though daily activity was slightly higher in fuel attendants (26.0% vs 24.0%). Known medical conditions were more prevalent in administrative staff (23.0% vs 14.0%).

Occupational hazards shared some similarities but differed in certain aspects: all staff were exposed to fuel/fumes but fuel attendants reported higher physical stress (80.0% vs 63.0%), whereas administrative staff were more likely to have ever checked BP or pulse rate (74.0% vs 60.0%).

Table 2. *Descriptive Statistics of Anthropometric and Cardiovascular Parameters of Respondents (N = 400).*

Parameter	Fuel Attendants (n = 200) Mean ± SD	Administrative Staff (n = 200) Mean ± SD	Total (N = 400) Mean ± SD
Weight (kg)	69.8 ± 9.4	74.2 ± 10.6	72.0 ± 10.0
Height (m)	1.71 ± 0.07	1.69 ± 0.06	1.70 ± 0.07
BMI (kg/m^2)	23.9 ± 2.8	26.0 ± 3.6	25.0 ± 3.3
Pulse Rate (bpm)	74.6 ± 6.8	88.2 ± 8.4	81.4 ± 9.6
Systolic BP (mmHg)	122.8 ± 11.8	148.4 ± 13.2	135.6 ± 17.5
Diastolic BP (mmHg)	80.1 ± 7.9	96.2 ± 9.1	88.2 ± 10.3

Statistical Interpretation

Fuel attendants maintained lower mean weight (69.8 kg) but were slightly taller (1.71 m) than administrative staff. Consequently, administrative staff displayed a higher BMI (26.0 kg/m^2). Cardiovascular indices differed markedly: administrative staff recorded hypertensive-level mean systolic and diastolic blood pressures (148.4/96.2 mmHg) and a significantly elevated pulse rate (88.2 bpm), compared to fuel attendants (122.8/80.1 mmHg, 74.6 bpm).

Table 3. *Independent Samples T-Test - Systolic and Diastolic Blood Pressure.*

Parameter	Fuel Attendants (n = 200) Mean ± SD	Administrative Staff (n = 200) Mean ± SD	t-value	p-value
Systolic BP (mmHg)	122.8 ± 11.8	148.4 ± 13.2	10.24	<0.001*
Diastolic BP (mmHg)	80.1 ± 7.9	96.2 ± 9.1	9.86	<0.001*

*Significant at $p < 0.05$

There is a significant difference in systolic and diastolic blood pressure between the two groups, with administrative staff having higher values.

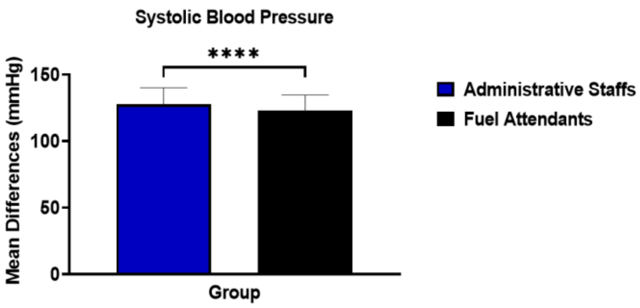

Figure 1. Data are expressed as mean ± SD (n = 200).

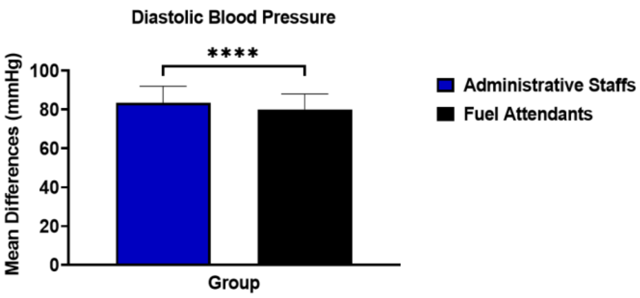

Figure 2. Data are expressed as mean ± SD (n = 200).

Table 4. Independent Samples T-Test - Pulse Rate.

Group	n	Mean ± SD (bpm)	t-value	p-value
Fuel Attendants	200	74.6 ± 6.8		
Administrative Staff	200	88.2 ± 8.4	11.62	<0.001*

*Significant at $p < 0.05$

Administrative staff had a significantly higher mean pulse rate compared to fuel attendants.

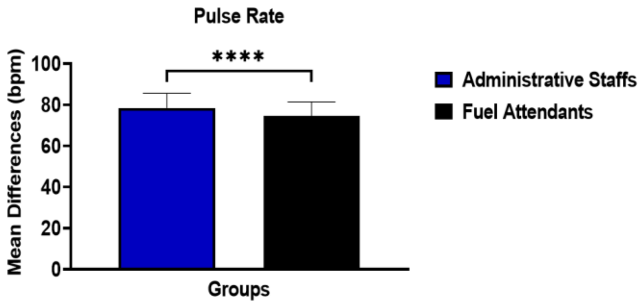

Figure 3. Data are expressed as mean ± SD (n = 200).

Table 5. Independent Samples T-Test - Anthropometric Indices.

Parameter	Fuel Attendants (n = 200) Mean ± SD	Administrative Staff (n = 200) Mean ± SD	t-value	p-value
Weight (kg)	69.8 ± 9.4	74.2 ± 10.6	4.12	<0.001*
Height (m)	1.71 ± 0.07	1.69 ± 0.06	1.66	0.098
BMI (kg/m^2)	23.9 ± 2.8	26.0 ± 3.6	5.72	<0.001*

*Significant at $p < 0.05$

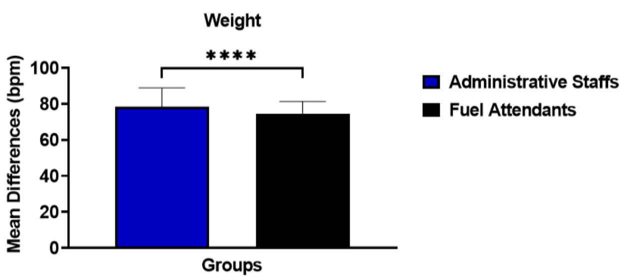

Figure 4. Data are expressed as mean ± SD (n = 200).

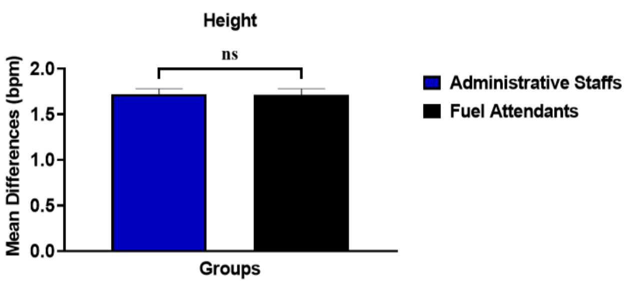

Figure 5. Data are expressed as mean ± SD (n = 200).

Administrative staff had significantly higher weight and BMI (74.2 kg, 26.0 kg/m^2) than fuel attendants (69.8 kg, 23.9 kg/m^2; $p < 0.001$). Height differences were not significant.

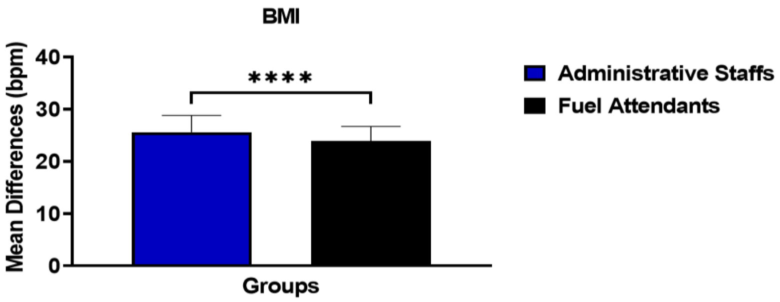

Figure 6. Data are expressed as mean ± SD (n = 200).

Table 6. Association between Socio-Demographic/Lifestyle Factors and blood pressure/Pulse Rate.

Factor	χ^2	Df	p-value
Age group vs Systolic BP	15.24	3	0.001*
Sex vs Pulse Rate	10.65	1	0.001*
Educational level vs BP	18.42	3	<0.001*
Physical activity vs BP	12.58	3	0.006*
Smoking status vs Pulse Rate	14.11	1	<0.001*

*Significant at p < 0.05

Interpretation: Chi-square tests revealed significant associations between cardiovascular parameters and factors such as age group, sex, educational level, physical activity, and smoking status (all $p < 0.05$), indicating that these variables influence blood pressure and pulse rate.

Table 7. Prevalence of Elevated BP and Abnormal Pulse Rate.

Parameter	Fuel Attendants (n = 200)	Administrative Staff (n = 200)	χ^2	p-value
Elevated BP (≥140/90 mmHg)	38 (19.0%)	112 (56.0%)	41.76	<0.001*
Abnormal Pulse Rate (<60 or >100 bpm)	12 (6.0%)	38 (19.0%)	14.54	<0.001*

*Significant at p < 0.05

Interpretation: The prevalence of elevated BP was markedly higher in administrative staff (56.0%) than in fuel attendants (19.0%, $p < 0.001$). Abnormal pulse rates were also more common in administrative staff (19.0% vs 6.0%). These patterns highlight the cardiovascular benefits of routine isometric handgrip activity among fuel attendants.

4. Discussion

This study compared the cardiovascular parameters, anthropometric indices, lifestyle behaviors, and work-related stress factors between fuel attendants and administrative staff of petrol stations in Delta State, Nigeria. The aim was to determine whether occupational physical demands involving isometric exercise influence cardiovascular health outcomes. A total of 400 participants were studied (200 fuel attendants and 200 administrative staff). Statistical analysis revealed highly significant differences in systolic and diastolic blood pressure, pulse rate, body mass index (BMI), work stress exposure, and medical history between both groups.

The socio-demographic profile (Table 1) highlights distinct differences between the two occupational categories. Males predominated among fuel attendants (71.0%), while females were the majority among administrative staff (52.0%), reflecting occupational gender patterns [41-43]. Educational attainment was higher among administrative staff (68.0% tertiary vs. 15.0%), which may enhance health awareness but not necessarily translate into healthier cardiovascular outcomes, as seen in this study. Fuel attendants had shorter work experience (51.0% with 1-5 years) and lower income (59.0% earning < ₦30,000), yet their occupation required sustained physical effort. Work schedules also differed markedly: while 95.0% of administrative staff worked day shifts, 45.0% of attendants worked rotating shifts and 13.0% worked night shifts, both of which have metabolic implications. Although irregular shifts can stress the body, the continuous isometric handgrip effort of the fuel attendants appear to yield better cardiovascular adaptation compared to prolonged sedentary postures in office workers [44, 45].

Results from Tables 2 and 3 revealed that administrative staff had markedly hypertensive blood pressure values, with mean systolic and diastolic readings of 148.4 ± 13.2 mmHg and 96.2 ± 9.1 mmHg, respectively, compared to 122.8 ± 11.8 mmHg and 80.1 ± 7.9 mmHg recorded among fuel attendants ($p < 0.001$). Similarly, pulse rate was substantially higher among administrative staff (88.2 ± 8.4 bpm) than among fuel attendants (74.6 ± 6.8 bpm). These values indicate that the administrative staff, whose work is largely sedentary, are predominantly within the hypertensive range, whereas the fuel attendants maintain near-normal cardiovascular indices. This finding contrasts with earlier studies [9] that observed elevated BP among petrol attendants due to exposure to volatile organic compounds (VOCs) however the blood pressure values in both studies for fuel attendants are within similar range. The difference between the two groups may be attributed to the constant isometric handgrip activity intrinsic to fuel attendants' work, which has been demonstrated to improve vascular tone, autonomic balance, and overall cardiac efficiency. Isometric handgrip exercise, performed continuously during fuel dispensing, has been shown in controlled studies to reduce both systolic and diastolic blood pressures by enhancing endothelial function and increasing nitric oxide bioavailability [26, 28, 29]. The sustained muscular contractions activate the baroreflex mechanism, lower sympathetic drive, and increase vagal modulation all of which improve resting blood pressure and heart rate. This physiological adaptation explains why fuel attendants in this study, despite chronic VOC exposure, exhibited healthier cardiovascular indices compared to the hypertensive administrative group. Conversely, administrative staff whose work involves long periods of sitting, limited movement, and psychosocial stress exhibited significantly higher BMI (26.0 ± 3.6 kg/m^2) and pulse rate (88.2 bpm), consistent with findings linking sedentary behavior to arterial stiffness, metabolic dysfunction, and poor autonomic regulation [46-48]. Prolonged sitting diminishes venous return, impairs nitric oxide-mediated vasodilation, and increases vascular resistance [49]. These pathophysiological changes, combined with poor physical activity, likely contributed to the elevated BP and RHR observed among administrative workers in contrast with fuel attendants. The contrast between both groups supports the concept that occupational physical engagement especially through isometric exercise serves as an independent protective factor for cardiovascular health. The repetitive handgrip activity among fuel attendants mimics structured isometric training regimens that are known to reduce systolic and diastolic blood pressure [23, 26, 27, 29, 30]. Such adaptations not only reduce resting BP but also enhance autonomic tone and vascular elasticity, mitigating the long-term risks of hypertension.

Anthropometric analysis also demonstrated significant occupational influence. Administrative staff weighed more (74.2 ± 10.6 kg) with higher BMI (26.0 ± 3.6 kg/m^2) compared to attendants (69.8 ± 9.4 kg, 23.9 ± 2.8 kg/m^2). The lack of significant difference in height ($p = 0.098$) suggests that these disparities arise primarily from lifestyle and energy balance differences rather than genetic factors. Sedentary occupations are linked to energy imbalance, visceral adiposity, and vascular inflammation all potent predictors of hypertension and cardiovascular disease [50, 51]. Meanwhile, the caloric expenditure associated with daily fuel dispensing helps attendants maintain favorable body composition, aligning with recommendations advocating regular muscular activity to maintain cardiometabolic health.

Chi-square analysis confirmed significant associations between cardiovascular indices and modifiable behaviors such as physical activity ($p = 0.006$) and smoking ($p < 0.001$). Individuals engaging in regular physical activity including occupational isometric effort showed lower BP levels. Smoking, in contrast, elevated pulse rate through sympathetic stimulation [6]. Interestingly, even though administrative staff possessed higher educational levels, their cardiovascular parameters were poorer, reinforcing that occupational lifestyle can override knowledge-based preventive advantages. The prevalence data underscored these patterns: 56.0% of administrative staff had elevated BP (≥140/90 mmHg), compared to 19.0% among fuel attendants, while abnormal pulse rate occurred in 19.0% of administrative staff versus 6.0% of attendants ($p < 0.001$). These findings emphasize that sedentary work independently predisposes individuals to hypertension and cardiovascular irregularities.

Although fuel attendants are continually exposed to petroleum fumes containing VOCs such as benzene and toluene, the physiological resilience conferred by their isometric occupational activity appears to offset some of the oxidative and autonomic stress risks associated with these compounds [16, 50]. The daily repetition of handgrip exertion enhances cardiac efficiency and endothelial responsiveness, producing a cardioprotective effect even within a chemically adverse environment. Overall, this study affirms that while both occupational groups are exposed to stressors, administrative staff exhibit hypertension and elevated pulse rates linked to inactivity, whereas fuel attendants benefit from the protective cardiovascular adaptations derived from continuous isometric handgrip activity. These results underscore the growing importance of integrating simple isometric training into sedentary workplace routines as a preventive measure against hypertension and related cardiovascular disorders.

5. Conclusion

The findings of this study reveal that administrative staff exhibited significantly higher mean systolic and diastolic blood pressure (148.4/96.2 mmHg), pulse rate (88.2 bpm), BMI (26.0 kg/m^2), and prevalence of hypertension (56.0%) compared to fuel attendants, despite working within the same petroleum environment. In contrast, fuel attendants demonstrated comparatively better cardiovascular indices, attributed to the protective effect of the occupational isometric handgrip exercise inherent in their job. This study thus reinforces the concept that regular, low-intensity isometric activity, even when performed as part of daily occupational tasks, can substantially enhance cardiovascular health, improve autonomic regulation, and mitigate hypertension risk.

6. Recommendations

Regular cardiovascular screening should be implemented for all petrol station workers to enable early detection of hypertension. Incorporating simple isometric handgrip exercises into office routines is strongly advised, as it effectively lowers blood pressure and improves cardiovascular health. Fuel attendants should maintain protective measures against fuel vapors through proper ventilation and consistent use of PPE. Health education on exercise, diet, and lifestyle modification should be emphasized for both groups. Overall, isometric handgrip exercise should be adopted as a low-cost workplace strategy to enhance cardiovascular health and prevent hypertension.

7. Limitations of the Study

This research was limited by its cross-sectional design, which restricts causal interpretation of the observed associations between occupational exposure, physical activity levels, and cardiovascular health outcomes. Lifestyle and health behavior data relied on self-reported responses, which may have been affected by recall bias and social desirability tendencies. The absence of biochemical measurements, such as BTEX metabolite analysis, reduced the ability to directly quantify petroleum vapor exposure levels among fuel attendants. Sampling was restricted to Delta State, thereby limiting generalizability to other regions with differing climatic conditions, work practices, and regulatory enforcement. In addition, potential confounders such as dietary habits outside the workplace, genetic predisposition to hypertension were not comprehensively controlled for in the analysis.

8. Contribution to Knowledge

This study provides an important addition to occupational health literature by revealing that the nature and type of job especially those involving isometric handgrip exercise could offer cardiovascular protection despite the chronic exposure to petroleum vapors. This finding challenges the conventional assumption that petroleum workers are at greater immediate cardiovascular risk, underscoring the underestimated influence of isometric handgrip exercise in cardiovascular health. The study advances a dual-risk interaction perspective, demonstrating that active occupational engagement can partially offset the detrimental cardiovascular effects of environmental hazards. Furthermore, it delivers baseline cardiovascular and lifestyle data for fuel attendants and administrative workers in Delta State, offering a valuable reference for future surveillance, occupational health interventions, and policy development.

Abbreviations

ACC	American College of Cardiology
AHA	American Heart Association
ANOVA	Analysis of Variance
BMI	Body Mass Index
BP	Blood Pressure
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
DBP	Diastolic Blood Pressure
LGA	Local Government Area
MVC	Maximum Voluntary Contraction
PAR-Q	Physical Activity Readiness Questionnaire
PMS	Premium Motor Spirit
PPE	Personal Protective Equipment
SBP	Systolic Blood Pressure
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
VOCs	Volatile Organic Compounds

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Conflicts of Interest

The authors wish to declare that there are no potential conflicts of interest that could partially or fully prejudice the research report.

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