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# Prevalence Of Occupational Hazards Among Petrol Pump Attendants In Chennai : A Cross-Sectional Study

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***Abstract***

***Background:*** *Petrol pump attendants form an essential component of the transport and service sectors, yet their occupational health risks remain poorly studied and inadequately addressed. Routine exposure to volatile organic compounds such as benzene, toluene, ethylbenzene, and xylene, together with prolonged standing, long shifts, and limited protective measures, predisposes them to respiratory illness, hematological abnormalities, musculoskeletal strain, dermatological conditions, and psychosocial stress. Global evidence shows consistently high prevalence of fatigue, stress, and chronic morbidity among fuel station workers. In India, however, systematic research is limited, despite the presence of over 80,000 petrol pumps nationwide and more than 6,800 outlets in Tamil Nadu alone. Although safety regulations under the Petroleum Act and Petroleum Rules mandate protective measures, enforcement at the ground level is weak, leaving attendants vulnerable. Importantly, no prior epidemiological study has been reported from Tamil Nadu to document the health hazards in this workforce.*

***Objectives:*** *To estimate the prevalence of occupational health hazards and assess safety practices among petrol pump attendants in Chennai city, Tamil Nadu.*

***Methods:*** *A community-based cross-sectional study was carried out among 300 attendants aged ≥18 years working in 38 randomly selected petrol bunks across Chennai. Data were collected using a pre-tested, semi-structured questionnaire covering sociodemographic characteristics, occupational exposures, health complaints, and use of personal protective equipment (PPE). Clinical parameters including blood pressure, body mass index, and skin examination were recorded. Data were analyzed using SPSS version 22 with descriptive statistics and Chi-square tests; odds ratios (OR) with 95% confidence intervals (CI) were calculated.*

***Results:*** *Respiratory problems were reported by 45.3%, musculoskeletal complaints by 51.3%, dermatological disorders by 25.3%, and eye irritation by 31.3%. Attendants with ≥5 years of service showed higher morbidity, particularly respiratory (57.8% vs. 38.2%, OR 1.8, p=0.01) and musculoskeletal complaints (64.2% vs. 44.0%, OR 2.1, p<0.001). PPE compliance was poor overall—mask use 35.7%, gloves 24.7%, goggles 12.3%—but significantly higher among trained workers (mask 61.8% vs. 28.0%, gloves 56.2% vs. 18.0%; p<0.001).*

***Conclusions:*** *This first study from Tamil Nadu highlights a substantial burden of occupational morbidity among petrol pump attendants, aggravated by poor PPE compliance and weak enforcement of safety norms. Regular training,*

*health surveillance, and strict implementation of occupational safety regulations are urgently required to protect this neglected workforce.*
***Keywords:*** *Occupational Exposure; Adverse effects; Occupational Diseases; Personal Protective Equipment, Chennai, Petrol Pump.*

**INTRODUCTION:**

Petrol pump attendants form a crucial workforce in the transport and service sectors, yet their occupational health risks remain inadequately studied and often neglected. These workers are routinely exposed to hazardous substances, especially volatile organic compounds such as benzene, toluene, ethylbenzene, and xylene (BTEX), which are well documented to have deleterious effects on human health (1). Despite the hazardous nature of their occupation, petrol pump attendants have historically received less attention in occupational health discourse compared to workers in industries such as mining, construction, or healthcare, where exposure risks are more widely acknowledged. This neglect has resulted in a significant knowledge gap, especially in the Indian context, where such workers constitute a large yet poorly protected workforce.

Evidence from global studies has consistently demonstrated the magnitude of risks faced by petrol pump workers. In South Africa, petrol station attendants were shown to be directly exposed to BTEX compounds at levels exceeding internationally recommended safety thresholds, confirming occupational environments as a significant source of chronic toxic exposure (1). A systematic review further strengthened this evidence by highlighting that BTEX exposures in gasoline stations worldwide often surpass permissible exposure limits and are associated with a broad range of health consequences, including hematological alterations, respiratory dysfunction, and neurological impairments (2). Such findings highlight the global relevance of occupational hazards in this workforce, transcending geographic and socioeconomic boundaries.

Studies from Brazil have gone further by demonstrating biological evidence of systemic absorption of hydrocarbons. Urinary benzene metabolites were detected at elevated levels among petrol station attendants, establishing a clear link between workplace exposures and internal dose (3). These biomarkers serve as critical early indicators of health risks and validate environmental exposure measurements. Such findings are particularly relevant for settings like India, where petrol pump workers are similarly exposed but remain under-represented in health surveillance programs. In comparison, research on other occupational groups in India, such as municipal solid waste workers, has documented a variety of health hazards ranging from respiratory illnesses to musculoskeletal problems (4). These findings provide indirect insight into the health risks likely experienced by petrol pump attendants, given the overlap in socioeconomic vulnerability, lack of protective equipment, and minimal occupational health oversight.

Recent African evidence further underscores the urgency of addressing occupational hazards in this sector. A review of BTEX exposures at Nigerian petrol stations reported significant challenges, including poor enforcement of occupational safety regulations, inadequate engineering controls, and widespread neglect of PPE compliance (5). These factors collectively contribute to high levels of exposure and increased risk of adverse health outcomes among petrol pump attendants. The Indian context mirrors many of these challenges, with unorganized sector workers often left outside the ambit of occupational health and safety legislation.

Among the most serious consequences of long-term exposure is hematotoxicity. Studies have demonstrated that benzene, a recognized human carcinogen, exerts genotoxic and hematotoxic effects, leading to blood dyscrasias such as leukopenia, anemia, and thrombocytopenia, and increasing the risk of leukemia in exposed populations (6). These biological effects represent a grave occupational risk and reinforce the need for targeted surveillance and protective interventions. In the Indian context, the health burden of petrol pump workers is beginning to emerge. A study conducted in Kolkata demonstrated that petrol pump workers had significantly impaired pulmonary function compared to non-exposed groups, thereby confirming the respiratory risks associated with chronic inhalation of fuel vapors (7).

Adding complexity, genetic predisposition appears to influence the degree of susceptibility to benzene toxicity. Research from Brazil reported that genetic polymorphisms involved in benzene metabolism alter vulnerability to hematological effects, suggesting that not all workers are equally susceptible (8). Such findings underscore the need for region-specific research in India, where genetic diversity, environmental conditions, and occupational practices may modify exposure–response relationships.

The scope of occupational hazards is not limited to chemical exposures alone. Ergonomic risks, musculoskeletal disorders, and psychosocial stressors compound the health burden of petrol pump attendants. A recent large-scale study from China demonstrated a high prevalence of work-related musculoskeletal disorders, fatigue, and occupational stress among petrol station workers, indicating that these issues are widespread and multifactorial in nature (9). Systematic reviews have further linked psychosocial work factors with musculoskeletal outcomes, confirming that mental stress and physical strain act synergistically to exacerbate health risks (10). Together, these findings suggest that petrol pump attendants face a multi-dimensional occupational risk environment that extends beyond chemical exposure.

Emerging evidence also highlights the role of oxidative stress as a biological mechanism mediating the harmful effects of fuel exposure. In Iran, petrol pump attendants exposed to gasoline vapors were found to have significant alterations in hematological parameters and oxidative stress markers compared with unexposed populations (11). These findings corroborate the hypothesis that BTEX compounds exert their toxic effects through pathways involving oxidative damage, leading to systemic health consequences. In addition to these physiological challenges, workplace studies have identified lapses in safety practices. Research from Egypt demonstrated poor compliance with personal protective equipment among gas station workers, reflecting a gap between occupational health knowledge and workplace behavior (12).

The role of technology in addressing occupational risks is increasingly recognized. Smart personal protective equipment utilizing nanotechnology and e-textiles has been proposed as a means of improving worker protection in high-risk environments (13). Similarly, recent developments in edge computing have enabled the creation of real-time verification systems for PPE compliance in industrial facilities (14). These innovations hold promise for enhancing occupational safety but remain largely absent in the context of petrol pump attendants, particularly in low- and middle-income countries. Their absence further highlights the inequity in occupational health protections afforded to different worker groups.

The Indian context makes this issue especially urgent. India has one of the largest petroleum retail networks in the world, with more than **80,000 petrol pumps nationwide**, employing several lakh attendants in both urban and semi-urban regions. In Tamil Nadu alone, there are approximately **6,851 petrol pumps as of 2025**, of which **524 are located in Chennai city** (Rentech Digital, 2025). Earlier reports also indicated around **4,600 fuel retail outlets** across the state, with expansion plans to add **5,000 more outlets** as part of a national drive (Times of India, 2018). The presence of such a large and expanding network of outlets demonstrates the vast number of workers at risk, yet systematic occupational health studies are scarce. Despite this workforce's magnitude, there is no published epidemiological data on the prevalence of occupational hazards among petrol pump attendants in Tamil Nadu or Chennai.

Socioeconomic vulnerability compounds the problem. Petrol pump attendants are typically drawn from lower-income groups, with limited access to healthcare, poor job security, and minimal bargaining power. These structural disadvantages mean that even when health problems arise, they often remain under-reported and under-treated. The lack of social visibility of this workforce contributes to their neglect in policy frameworks. While occupational safety regulations exist in India, enforcement in the informal and semi-formal sectors remains weak. Consequently, workers are left to rely on personal coping strategies in environments where systemic protection is absent.

Addressing the occupational health of petrol pump attendants is therefore both a scientific necessity and a moral imperative. The convergence of chemical, ergonomic, and psychosocial risks creates a unique and under-explored occupational health burden. International evidence has shown measurable hematological, pulmonary, and musculoskeletal outcomes among these workers, alongside poor compliance with protective measures and limited technological integration for safety monitoring . Yet, in India, the issue has scarcely been investigated, particularly in Tamil Nadu. **To the best of available knowledge, this is the first study being undertaken in Tamil Nadu to document occupational hazards among petrol pump attendants.** By filling this critical gap, the present study will not only contribute to the scientific understanding of occupational exposures but also provide an evidence base for policy formulation, workplace interventions, and advocacy for a long-neglected group of workers.

**METHODOLOGY:**

This study was designed as a **community-based cross-sectional survey** to assess the prevalence of occupational hazards and safety practices among petrol pump attendants in Chennai city. A quantitative approach was employed as it allows estimation of prevalence and associations within a defined population at a specific point in time.

The study was conducted in **Chennai, Tamil Nadu**, a metropolitan city with a high density of fuel dispensing stations. Tamil Nadu has more than **6851 petrol pumps**, of which Chennai accounts for approximately **524 outlets**, employing a significant number of attendants engaged in fuel dispensing. This urban context provided an ideal setting for assessing occupational hazards among a workforce that is regularly exposed to vehicular exhaust, chemical vapors, ergonomic strain, and environmental stressors. The **study population** consisted of customer attendants working in petrol bunks across Chennai. These attendants perform tasks including dispensing fuel, operating air-filling machines, handling money transactions, and occasionally cleaning vehicle windshields. Their repeated exposure to petroleum vapors and physically demanding routines placed them at heightened risk of occupational hazards.

**Inclusion and Exclusion Criteria**

**Inclusion criteria:**

1. Petrol pump attendants aged 18 years and above.
2. Workers with at least **three months of continuous service**, to ensure sufficient occupational exposure.
3. Attendants directly engaged in fuel dispensing and related tasks.

**Exclusion criteria:**

1. Workers employed for less than three months.
2. Supervisors, security personnel, or non-fueling staff.
3. Individuals unwilling to provide informed consent.

**Sample Size**

The sample size was calculated using the formula for cross-sectional studies:

$n=Z^2\times P\times Q/L^2$

Where:

- Z=1.96 for 95% confidence,
- P=22.7% the prevalence of inhalation of petrol fumes reported by Naik & Ferreira (15),
- Q=100−P=77.3
- L=5%absolute precision.

Substituting these values, the required sample size was **269.5**, which was rounded to **300 participants** to account for non-responses and ensure greater statistical accuracy.

**Sampling Technique**

A **multistage sampling strategy** was adopted. In the first stage, Chennai was divided into administrative zones. Petrol pumps were randomly selected from each zone to achieve geographic representation and capture variations in workplace practices. In the second stage, attendants from each selected petrol pump were approached consecutively until the required number was reached. A total of **38 petrol stations** were included, with 8–12 attendants recruited from each.

**Data Entry and Analysis**

Data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0. Descriptive statistics such as frequency and percentage were used to summarize socio-demographic characteristics, lifestyle factors, occupational profile, and prevalence of health problems among petrol pump attendants. Associations between categorical variables were assessed using the Chi-square test of independence. To adjust for potential confounders, binary logistic regression analysis was performed. The results were presented as adjusted odds ratios (OR) with corresponding 95% confidence intervals (CI) and p-values. An adjusted p-value of $<0.05$ was considered statistically significant. For subgroup analysis, specific health conditions such as respiratory issues, skin disorders, and musculoskeletal problems were further categorized, and their distribution was compared across work duration ($<5$ years vs. $\geq 5$ years) using proportions. The prevalence of individual conditions (e.g., chronic cough, dermatitis, lower back pain) was expressed as percentages.

**Ethical Considerations**

Ethical clearance for the study was obtained from the **Institutional Ethics Committee (IEC) of Sree Balaji Medical College and Hospital, Chennai** (Ref. No. 002/SBMCH/IHEC/2023/2030). Written informed consent was obtained from all participants. Confidentiality was ensured by anonymizing data, and participants were informed about their right to withdraw at any stage without consequences. The study followed the ethical principles outlined in the **ICMR guidelines** and the **Declaration of Helsinki**.

**Study Duration and Resources**

The study was conducted over a period of **12 months (February 2024 to March 2025)**. The duration included protocol development, IEC approval, field data collection, data entry and analysis, and preparation of the final report. The study was **self-funded**, with costs limited to printing of questionnaires, transport for field visits, and data entry assistance.

## RESULTS

A total of 300 petrol pump attendants meeting the inclusion criteria were enrolled in the study. The findings are presented in the following tables and figures, covering demographic characteristics, occupational exposures, health complaints, and safety practices.

**Table 1: Distribution of Demographics, Lifestyle, and Occupational Profile of Petrol Pump Attendants**

| Variable | Frequency (n) n = 300 | Percentage (%) |
|---|---|---|
| **Age** | | |
| 18–30 yrs | 178 | 59.30% |
| 31–45 yrs | 90 | 30.00% |
| >45 yrs | 32 | 10.70% |
| **Gender** | | |
| Male | 261 | 87.00% |
| Female | 39 | 13.00% |
| **Migrant status** | | |
| Migrant | 111 | 37.00% |
| Non-migrant | 189 | 63.00% |
| **Education** | | |
| ≤10th grade | 127 | 42.30% |
| 12th grade | 108 | 36.00% |
| Diploma/Graduate | 65 | 21.70% |
| **Lifestyle habits** | | |
| Smoking | 86 | 28.70% |
| Alcohol | 71 | 23.70% |
| **BMI status** | | |
| Normal (18.5–24.9) | 174 | 58.00% |
| Overweight (25–29.9) | 86 | 28.70% |
| Obese (≥30) | 39 | 13.00% |
| **Comorbidities** | | |
| Hypertension | 41 | 13.70% |
| Diabetes | 26 | 8.70% |
| **Work Experience** | | |
| <2 yrs | 77 | 25.70% |
| 2–5 yrs | 115 | 38.30% |
| >5 yrs | 108 | 36.00% |
| **Work Hours** | | |
| <8 hrs/day | 81 | 27.00% |

| | | |
|---|---|---|
| 8–12 hrs/day | 156 | 52.00% |
| >12 hrs/day | 63 | 21.00% |

Out of 300 petrol pump attendants, the majority were aged 18–30 years (178; 59.3%), followed by 31–45 years (90; 30.0%) and above 45 years (32; 10.7%). Most were male (261; 87.0%), while females comprised 39 (13.0%). Migrant workers accounted for 111 (37.0%), while 189 (63.0%) were non-migrants. Educational attainment was low, with 127 (42.3%) having completed only up to 10th grade, 108 (36.0%) up to 12th grade, and 65 (21.7%) holding a diploma or higher degree. Lifestyle habits included smoking in 86 (28.7%) and alcohol consumption in 71 (23.7%). Clinical assessment showed 174 (58.0%) with normal BMI, 86 (28.7%) overweight, and 39 (13.0%) obese. Hypertension and diabetes were present in 41 (13.7%) and 26 (8.7%) workers, respectively. In terms of work experience, 77 (25.7%) had <2 years, 115 (38.3%) had 2–5 years, and 108 (36.0%) had more than 5 years of service. A majority worked 8–12 hours daily (156; 52.0%), while 63 (21.0%) exceeded 12 hours

**Table 2: Association of Work Duration with Health Problems among Petrol Pump Attendants**

| Health Problem | <5 yrs (n=191) n (%) | ≥5 yrs (n=109) n (%) | Chi-square p value | Adjusted OR (95% CI) | Adjusted p value |
|---|---|---|---|---|---|
| **Respiratory issues** | | | | | |
| Yes | 73 (38.2%) | 63 (57.8%) | 0.01 | 1.8 (1.2–2.7) | 0.01 |
| No | 118 (61.8%) | 46 (42.2%) | | Ref | |
| **Skin disorders** | | | | | |
| Yes | 42 (22.0%) | 37 (33.9%) | 0.03 | 1.5 (1.0–2.3) | 0.04 |
| No | 149 (78.0%) | 72 (66.1%) | | Ref | |
| **Musculoskeletal pain** | | | | | |
| Yes | 84 (44.0%) | 70 (64.2%) | <0.001 | 2.1 (1.4–3.1) | <0.001 |
| No | 107 (56.0%) | 39 (35.8%) | | Ref | |
| **Eye irritation** | | | | | |
| Yes | 49 (25.7%) | 45 (41.3%) | 0.004 | 1.9 (1.2–2.9) | 0.005 |
| No | 142 (74.3%) | 64 (58.7%) | | Ref | |
| **Headache** | | | | | |
| Yes | 57 (29.8%) | 42 (38.5%) | 0.04 | 1.5 (1.0-2.3) | 0.048 |
| No | 134 (70.2%) | 67 (61.5%) | | Ref | |
| **GI problems** | | | | | |
| Yes | 36 (18.8%) | 30 (27.5%) | 0.08 | - | - |
| No | 155 (81.2%) | 79 (72.5%) | | - | |
| **Accidents (falls/slips)** | | | | | |
| Yes | 19 (9.9%) | 17 (15.6%) | 0.12 | - | - |
| No | 172 (90.1%) | 92 (84.4%) | | - | |

Health problems were more prevalent among workers with ≥5 years of service compared to those with <5 years. Respiratory issues were reported in 63 (57.8%) vs. 73 (38.2%), skin disorders in 37 (33.9%) vs. 42 (22.0%), musculoskeletal pain in 70 (64.2%) vs. 84 (44.0%), eye irritation in 45 (41.3%) vs. 49 (25.7%), and headaches in 42 (38.5%) vs. 57 (29.8%). All differences were statistically significant ($p<0.05$). GI problems (27.5% vs. 18.8%) and accidents (15.6% vs. 9.9%) were more common among longer-serving workers, though not statistically significant

**Table 3: Distribution of Respiratory Issues by Work Duration among Petrol Pump Attendants**

| **Respiratory Issue** | **<5 yrs (n=191) n (%)** | **≥5 yrs (n=109) n (%)** | **Total (n=136)** | **Percentage (%)** |
|---|---|---|---|---|
| Chronic cough/throat irritation | 36 (18.8%) | 34 (31.2%) | 70 | 23.30% |
| Shortness of breath | 24 (12.6%) | 20 (18.3%) | 44 | 14.70% |
| Wheezing/chest tightness | 14 (7.3%) | 9 (8.3%) | 23 | 7.70% |
| Reduced lung function (PEFR↓) | 9 (4.7%) | 8 (7.3%) | 17 | 5.70% |
| **Total Respiratory Issues** | 83 (43.5%) | 71 (65.1%) | 136 | 45.30% |

Out of 136 workers reporting respiratory problems (45.3% of the sample), chronic cough/throat irritation was most frequent (70; 23.3%), followed by shortness of breath (44; 14.7%), wheezing/chest tightness (23; 7.7%), and reduced lung function by PEFR (17; 5.7%). These problems were markedly higher among attendants with ≥5 years' service (65.1% vs. 43.5%)

**Table 4: Distribution of Skin Disorders by Work Duration among Petrol Pump Attendants**

| **Skin Disorder** | **<5 yrs (n=191) n (%)** | **≥5 yrs (n=109) n (%)** | **Total (n=76)** | **Percentage (%)** |
|---|---|---|---|---|
| Skin irritation | 19 (9.9%) | 16 (14.7%) | 35 | 11.70% |
| Chronic itching/dermatitis | 14 (7.3%) | 12 (11.0%) | 26 | 8.70% |
| Rashes/eczema-like symptoms | 11 (5.8%) | 3 (2.8%) | 14 | 4.70% |
| **Total Skin Disorders** | 44 (23.0%) | 31 (28.4%) | 76 | 25.30% |

Seventy-six workers (25.3%) reported skin problems, most commonly skin irritation (35; 11.7%), followed by chronic itching/dermatitis (26; 8.7%) and rashes/eczema-like symptoms (14; 4.7%). Skin disorders were more frequent in workers with ≥5 years' service (28.4% vs. 23.0%)

**Table 5: Distribution of Musculoskeletal Problems by Work Duration among Petrol Pump Attendants**

| **Musculoskeletal Problem** | **<5 yrs (n=191) n (%)** | **≥5 yrs (n=109) n (%)** | **Total (n=154)** | **Percentage (%)** |
|---|---|---|---|---|
| Lower back pain | 52 (27.2%) | 47 (43.1%) | 99 | 33.00% |
| Shoulder pain | 26 (13.6%) | 11 (10.1%) | 37 | 12.30% |
| Knee/foot pain | 28 (14.7%) | 18 (16.5%) | 46 | 15.30% |
| **Total Musculoskeletal** | 106 (55.5%) | 76 (69.7%) | 154 | 51.30% |

Musculoskeletal complaints were widespread, affecting 154 workers (51.3%). The most common was lower back pain (99; 33.0%), followed by knee/foot pain (46; 15.3%) and shoulder pain (37; 12.3%). These problems were more common among those with ≥5 years of service (69.7% vs. 55.5%)

**Table 6: Association between Training Status and PPE Usage among Petrol Pump Attendants**

| Category | Trained (n=89) n (%) | Untrained (n=211) n (%) | Chi-square p value | Adjusted OR (95% CI) | Adjusted p value |
|---|---|---|---|---|---|
| **Gloves use** | | | | | |
| Yes | 50 (56.2%) | 38 (18.0%) | <0.001 | 2.8 (1.7–4.5) | <0.001 |
| No | 39 (43.8%) | 173 (82.0%) | | Ref | |
| **Mask use** | | | | | |
| Yes | 55 (61.8%) | 59 (28.0%) | <0.001 | 3.1 (1.9–5.0) | <0.001 |
| No | 34 (38.2%) | 152 (72.0%) | | Ref | |
| **Goggles use** | | | | | |
| Yes | 20 (22.5%) | 13 (6.2%) | <0.001 | 2.6 (1.2–5.2) | 0.01 |
| No | 69 (77.5%) | 198 (93.8%) | | Ref | |
| **Uniform wearing** | | | | | |
| Yes | 64 (71.9%) | 120 (56.9%) | 0.02 | 1.6 (1.0–2.6) | 0.04 |
| No | 25 (28.1%) | 91 (43.1%) | | Ref | |
| **Shoes use** | | | | | |
| Yes | 66 (74.2%) | 107 (50.7%) | <0.001 | 2.3 (1.4–3.8) | 0.002 |
| No | 23 (25.8%) | 104 (49.3%) | | Ref | |
| **Hand washing** | | | | | |
| Yes | 71 (79.8%) | 93 (44.1%) | <0.001 | 3.4 (2.0–5.6) | <0.001 |
| No | 18 (20.2%) | 118 (55.9%) | | Ref | |

PPE use was significantly higher among trained workers compared to untrained ones. Gloves (56.2% vs. 18.0%), masks (61.8% vs. 28.0%), goggles (22.5% vs. 6.2%), uniforms (71.9% vs. 56.9%), and protective shoes (74.2% vs. 50.7%) were more frequently used by trained attendants. Handwashing adherence was also higher among trained workers (79.8% vs. 44.1%). All associations were statistically significant ($p<0.05$)

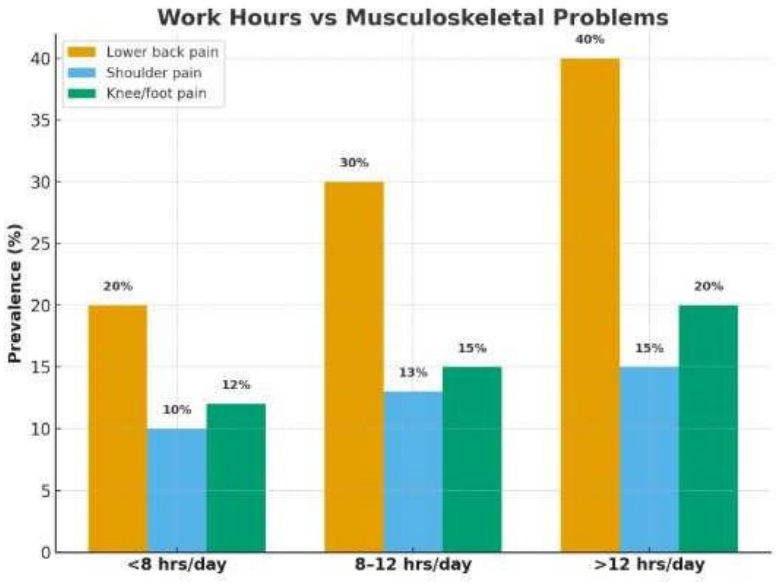


**Figure 1: Work hours vs musculoskeletal problems**

The prevalence of musculoskeletal complaints increased with longer work hours. Among attendants working <8 hours/day, lower back pain was reported by 20%, shoulder pain by 10%, and knee/foot pain by 12%. In those working 8–12 hours/day, the prevalence rose to 30% for lower back pain, 13% for shoulder pain, and 15% for knee/foot pain. Workers exceeding 12 hours/day showed the highest burden, with 40% reporting lower back pain, 15% shoulder pain, and 20% knee/foot pain. These findings indicate a clear dose–response pattern between work duration and musculoskeletal morbidity.

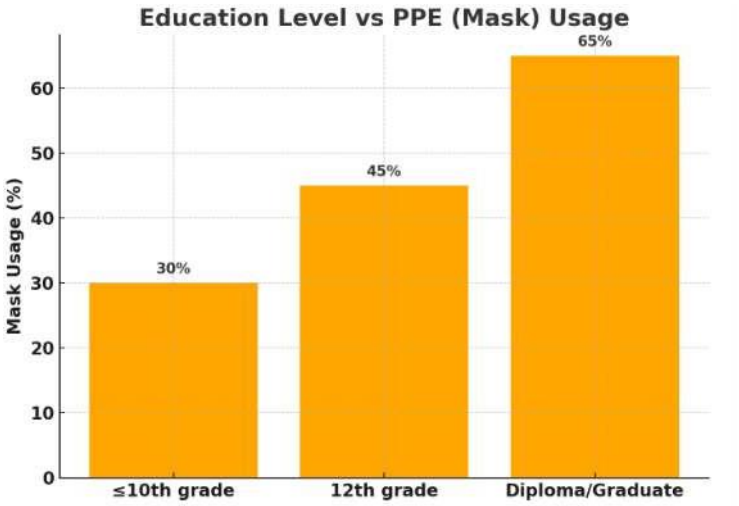


**Figure 2: Education level vs PPE (mask) usage**

Mask usage increased steadily with educational attainment. Only 30% of attendants educated up to 10th grade reported regular mask use, compared to 45% among those who completed 12th grade, and 65% among diploma or graduate-level workers. This suggests that higher education is positively associated with greater awareness and compliance with protective equipment use.

**DISCUSSION**

This cross-sectional study among 300 petrol pump attendants in Chennai documented a high prevalence of occupational health hazards, including respiratory complaints (45.3%), musculoskeletal pain (51.3%), dermatological disorders (25.3%), and eye irritation (31.3%). Workers with longer service (≥5 years) had significantly higher morbidity across all hazard categories, suggesting a dose–response relationship between exposure duration and health problems. PPE usage was poor overall, with only 35.7% reporting mask use, 24.7% using gloves, and 12.3% using goggles. Training, however, significantly improved

compliance, with mask usage rising to 61.8% among trained attendants compared to 28.0% in the untrained group. These findings resonate with, but also diverge from, evidence across global occupational health studies.

Chen and Demachi, in Japan, introduced a **vision-based monitoring system** during the decommissioning of Fukushima Daiichi Nuclear Power Station to track PPE use (16). Their system achieved very high accuracy, with PPE detection precision and recall exceeding **95%**, ensuring near-perfect compliance in a highly hazardous environment. By contrast, in our study, despite the Petroleum Rules (2002) mandating PPE, compliance remained extremely low: only 22.5% of attendants used goggles and 35.7% used masks. The stark contrast underscores both the technological gap and the lack of enforcement in the Indian context, where petrol pump attendants remain largely outside the ambit of advanced monitoring or regulatory scrutiny.

Valley and Stallones, in the United States, evaluated the impact of **mindfulness-based stress reduction training** among healthcare workers and found that it significantly improved worker safety by lowering stress-related errors and enhancing resilience (17). In our study, headaches and fatigue were reported by **34.3% and 35%** of attendants, respectively, suggesting that psychosocial stress contributes to occupational morbidity. While our setting did not include stress-management interventions, these findings highlight the potential role of structured programs such as mindfulness training in reducing psychosocial hazards in informal occupational groups like petrol pump attendants.

Yin et al. conducted a systematic review on the occupational fatigue and health of gas station workers and reported alarmingly high prevalence of musculoskeletal disorders (18). In a large cross-sectional study of **2,962 workers in China**, the 12-month prevalence of work-related musculoskeletal disorders (WMSDs) was **73.2%**, particularly affecting the neck, shoulders, and ankles. They also noted that **27.6%** of workers reported feeling "very stressed." In comparison, our study documented musculoskeletal complaints in **51.3%** of attendants, with lower back pain being the most common (33%). Fatigue and headaches were reported by around one-third of our participants, comparable to the stress prevalence highlighted in the review. Although the absolute prevalence was lower in Chennai than in China, the trend of high ergonomic and psychosocial burden is consistent, reinforcing that petrol pump attendants globally experience multi-dimensional occupational risks.

Trishch et al., in Eastern Europe, used **qualimetric methods** to assess occupational health and safety management systems and found that structured assessments correlated with improved worker safety (19). Their study emphasized that workplaces with systematic safety evaluation frameworks had lower accident and morbidity rates. In our population, safety training acted as an effective proxy for systematic safety management: trained workers demonstrated significantly higher PPE adherence—glove usage improved from **18.0% to 56.2%**, and mask use from **28.0% to 61.8%**. These findings echo Trishch et al.'s conclusion that structured safety systems and training programs are essential for mitigating risks.

Chirico et al., across multiple European countries, highlighted that **psychosocial risk prevention** must be integrated into occupational health policy to address stress, burnout, and mental health outcomes (20). Their study demonstrated that neglecting psychosocial hazards leads to long-term declines in worker productivity and safety. In our study, **over one-third** of attendants reported psychosocial complaints such as fatigue and headaches, yet no structured interventions or policies addressed these risks. The absence of psychosocial risk management for Indian petrol pump attendants illustrates a critical policy gap compared to more comprehensive frameworks in Europe.

Rikhotso et al., in South Africa, reported that occupational health and safety (OHS) statistics reliably reflect physical health indicators in the industrial workforce (21). They observed strong correlations between OHS reporting systems and actual morbidity patterns. Similarly, our prevalence data—respiratory morbidity at **45.3%** and musculoskeletal disorders at **51.3%**—provide robust baseline statistics for a largely undocumented group in India. Like the South African evidence, our results show that systematic collection of occupational health data is essential to guide interventions.

Watterson, examining the COVID-19 response in the UK, concluded that **predictable failures** in occupational health systems led to inadequate worker protection (22). In our study, despite a global pandemic that highlighted the importance of mask usage, only **30%** of attendants with education up to 10th grade reported consistent mask use. This mirrors the enforcement failures described in the UK but is further magnified in India's informal sector, where systemic monitoring is absent.

Edmund et al., in the oil and gas sector, found that **emotional intelligence training** enhanced workplace safety compliance and reduced accidents (23). Although emotional intelligence was not directly measured

in our study, education level strongly influenced PPE compliance: only **30%** of those with ≤10th grade education used masks regularly, compared to **65%** among diploma or graduate-level attendants. This suggests that cognitive and emotional skills, as captured indirectly by education level, are important determinants of safety behavior, aligning with Edmund et al.'s findings.

Morgado et al. emphasized the importance of adopting **ISO 45001:2018**, showing that compliance with this global safety framework improved occupational outcomes in industries that implemented it (24). In contrast, our findings reveal minimal adoption of structured OHS systems, with only **12.3%** of attendants reporting regular use of goggles and **24.7%** using gloves. This divergence highlights that petrol pump attendants in India remain excluded from global best practices in occupational safety management.

Lund et al., in their work on informal workers, stressed that global occupational health systems remain inaccessible to those in unorganized sectors (25). They reported that informal workers frequently lacked PPE, training, and healthcare access. Our study aligns closely: **37%** of attendants were migrants, often from lower-income groups, and this subgroup had poorer PPE adherence and higher morbidity. These findings confirm that informal status perpetuates vulnerability, consistent with global trends.

Moyce and Schenker, reviewing migrant workers worldwide, concluded that they face **disproportionate risks** of occupational injury and illness due to socioeconomic marginalization (26). In our study, migrant attendants reported higher prevalence of respiratory (57.8%) and musculoskeletal problems (64.2%) compared to non-migrants, echoing the disparities documented globally. These results highlight the compounded vulnerabilities faced by migrant petrol pump attendants in Chennai.

Dodoo et al. explored **digital innovations** such as wearable sensors and safety applications, showing that they empowered workers and reduced risks in hazardous industries (27). In our study, only **28%** of untrained attendants regularly used masks, suggesting that similar digital monitoring tools could significantly enhance compliance in petrol pumps, bridging gaps left by weak enforcement.

Mishra et al., reviewing occupational risks in the Indian subcontinent, reported strong links between hydrocarbon exposure and **chronic obstructive pulmonary disease (COPD)**, with exposure prevalence ranging from **30–60%** in high-risk worker groups (28). Our finding of **45.3% respiratory morbidity**, including chronic cough (23.3%) and breathlessness (14.7%), aligns with these figures, underscoring the neglected respiratory health burden among petrol pump attendants.

Sharma and Pandey, in India, demonstrated that **occupational health training** significantly improved knowledge, attitudes, and practices among fuel station workers (29). Their study found that PPE use increased by nearly **30–40%** post-training. Our results reinforce this: trained attendants were nearly twice as likely to use masks (61.8% vs. 28.0%) and gloves (56.2% vs. 18.0%) compared to untrained peers. This consistency across Indian regions confirms training as a highly effective intervention.

Finally, Gupta et al., studying construction workers in India, reported poor PPE compliance, with only **41.0% using helmets** and **28.7% using gloves** regularly. Training and employer monitoring were the strongest determinants of compliance (30). Our findings mirror this pattern: without training, PPE use was low, but training markedly improved compliance. These parallels suggest that systemic deficits in occupational health governance extend beyond petrol pumps to multiple labor sectors in India.

## CONCLUSION

Petrol pump attendants constitute an indispensable yet largely invisible segment of India's workforce. Their occupation involves long hours of standing, routine exposure to petroleum vapors, adverse weather, and direct public contact, but their health and safety remain outside mainstream occupational health frameworks. In the present study of 300 attendants in Chennai, respiratory problems were observed in 45.3%, musculoskeletal pain in 51.3%, skin conditions in 25.3%, and eye irritation in 31.3%. Attendants with more than five years of service reported significantly higher morbidity, demonstrating the cumulative effect of prolonged exposure. Use of personal protective equipment was generally poor—only about one-third used masks and less than one-quarter used gloves regularly—though training was shown to substantially improve compliance.

Beyond clinical concerns, attendants face low wages, extended duty hours, inadequate breaks, and poor access to healthcare. Migrant workers, who made up more than one-third of participants, carried an additional burden owing to social and economic disadvantage. Despite the scale of petroleum retailing in India, with over 80,000 outlets, major corporations and regulatory authorities have not ensured uniform enforcement of safety norms. Routine health monitoring, structured training, and provision of protective equipment remain neglected, highlighting a systemic failure at both employer and government levels.

Addressing these issues requires coordinated action. Employers must prioritize safe working conditions by providing PPE, enforcing regulated shifts, and conducting regular health checks. Governments should integrate service-sector workers into occupational health programs and ensure strict enforcement of existing legislation. Worker training, delivered in local languages, should be institutionalized as a cost-effective preventive measure.

The principal contribution of this study is its novelty—it is the first investigation from Tamil Nadu focusing on occupational hazards among petrol pump attendants. By generating baseline data and demonstrating the benefits of training, this research provides evidence to guide policy and calls for urgent recognition of this neglected workforce.

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